A MODEL PROCEDURE
FOR THE ECAP HOME ENERGY SURVEY

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Buildings and Urban Energy Divison
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PREFACE

This report describes a residential energy audit procedure which is proposed as a basis for the ECAP audit field test program in Prince Edward Island. Various revisions aimed at streamlining the initial draft are included.

The procedure was developed by Ron Argue of Millbank Associates and Sebastian Moffatt of Retrospectors Inc.

We would like to thank Bob Platts and Mike Swinton of Scanada Consultants and Rick Quirouette of the National Research Council for assistance on a variety of technical issues.

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INTRODUCTION

(a) Background

In the spring of 1981, Energy, Mines and Resources Canada invited Millbank Associates to participate in the development of an on-site residential energy auditing service which would support the objectives of the Enhanced Conservation Assistance Program (ECAP). The ECAP program provides special financial assistance for energy conservation measures to residents of oil-heated homes in PEI, Newfoundland, the Yukon and the Northwest Territories where conversion from oil via the Canadian Oil Substitution Program (COSP) grant is not possible due to the lack of competitive alterate fuels. The ECAP grant covers 50% of the cost of basic weatherization and oil retrofit measures up to a maximum of $800 and operates in addition to the standard CHIP home insulation grant of $500.

The objective of the ECAP audit is to engender more effective use of grant funds through the provision of accurate on-site advice to potential applicants. To test the feasibility and effectiveness of a free federally subsidized audit service, an initial pilot audit service is planned for PEI for the January - August 1982 period. Pilots in other ECAP regions will follow thereafter.

The purpose of the current paper is to document a model audit procedure which covers ECAP eligible measures and which will be suitable as a basis for field-testing and program development in PEI. Reviewers interested in the full program context should read Millbank's "Initial Guidelines" reports which provide a a general development strategy and outline supporting delivery, information, training, research, and evaluation requirements.

(b) The Audit Procedure

In developing the procedure described in the report, we have focused on defining an appropriate analytical methodology and incorporating it within an efficiently designed set of inspection forms which guide the energy adviser through the analysis and calculations required to arrive at the proper recommendations. Further work will be required to improve the "communications" side of the audit particularly in terms of the final format for presenting results and an accompanying set of fact sheets or brochures on consumer and technical issues.

The audit procedure covers a range of sealing, insulation, heating system and domestic hot water measures. The procedure has been structured to determine which of the possible measures is applicable to the home, to provide savings and cost estimates for those measures and to rank the measures in terms of optimum sequence of implementation. In its present form, the procedure is suitable only for oil-heated homes, although it could be applied to any heating fuel with minor adaptation.

The analytical approach is an extension of the current Enersave Class B system and offers a range of improvements including (1) improved accuracy and detail in recommendations as a result of on-site data collection (2) coverage of significantly more measures (approximately 25) and (3) the provision of a series of "maintenance" flags highlighting actions which should be taken before or in concert with standard retrofit actions to ensure effectiveness.

From a technical point of view, the procedure advances the "state-of-the-art" of on-site auditing in a variety of ways including:

(1) improved data collection system with pre-calculated and integrated savings and cost estimation factors
(2) improved insulation and sealing savings chart for the building envelope
(3) incorporation of a free heat correction factor
(4) improved estimation system for air changes
(5) simplified savings calculation procedures for domestic hot water and oil heating systems

The audit has been designed so that one adviser can inspect the residence, calculate cost and savings estimates for each measure and present the results before leaving the home.Various minor adaptations will have to be made to permit experimentation with two person or two-step systems. A one adviser system was chosen for the draft procedure since it is the simplest, cheapest, and most straightforward. It reduces staff requirements, simplifies the interaction with the client,and ensures clear uncomplicated communications. In addition, the one adviser system is most suitable for explaining the procedure and for field testing.

The procedure has evolved considerably on the basis of very limited field tests in Ottawa. However, it is clear that many issues and problems cannot be resolved until the extensive field test program planned for the PEI pilot has been carried out. Consequently the procedure has been primarily structured to facilitate field testing of various techniques and approaches and

and should not be regarded as a final approach. It is hoped that the procedure will be continually refined over the coming months until a final procedure suitable for implementation in a full pilot program for PEI ECAP applicants has been developed.

In this context, it is worth noting that an experienced adviser would require about 2½ hours to conduct the inspection and to manually perform the calculations for the current procedure. Since 2½ hours is targeted as the average completion time for the ECAP audit to keep costs and on-site time at acceptable levels, it will be necessary to use the field tests to streamline the analysis portion of the audit so that 30 - 60 minutes will be available for discussing the results of the audit with the householder.

To facilitate such streamlining, a calculator program which will allow the adviser to perform the audit calculations on a hand-held programmable calculator is now under development. Further consideration will be given to developing a "screening system" to allow the adviser to adjust the level of detail in calculations to the requirements of the home, and to the use of on-site terminals which have been used with reported success in the United States.

Finally it should be noted that the ECAP audit will be referred to as a home energy survey to avoid public confusion over the term 'audit'. Copies of the draft energy survey forms are provided in Appendix 1. Reference tables designed to assist the adviser in on-site degree-day and RSI calculations and in heating system assessment are shown in Appendix 2.

2. DESIGN REQUIREMENTS

The procedure has been designed following a review of all available audit procedures with particularly close scrutiny of the Instrumented Energy Audit System developed at Princeton University and the RCS system developed for the U.S. Department of Energy. The procedure is structured around the completion of a set of forms (see Appendix 1) which cover the analysis of each component of the building envelope and hot water and oil heating systems. The integrated form approach was chosen because it was felt that it best met the varied and complicated set of design requirements for the ECAP home energy survey.These include:

(1) to provide the householder with specific advice on all ECAP and CHIP eligible measures.

(2) to provide a sufficiently detailed analysis to enable ECAP authorities to determine if a householder's request for grant subsidization is cost-effective or optimal.

(3) to advise the householder where the effectiveness of energy conservation measures can be improved through basic maintenance requirements

(4) to develop data collection forms to standardize each inspection procedure and to simplify and streamline data collection and processing

(5) to simplify on-site area, RSI, cost and saving calculations through the use of pre-calculated cost factors and savings tables directly integrated with the data collection forms wherever possible

(6) to allow computerized data storage for program management, research, and evaluation purposes

(7) to collect data in sufficient detail to ensure that economic priorities are properly identified and hence to ensure a credible Federal profile

(8) to provide the householder with estimates of both do-it-yourself and contractor costs

(9) to provide the householder with an effective retrofit plan of action by priorizing recommended measures on the basis of payback and logical sequence of implementation

(10) to provide sufficient detail in the initial design to provide a basis for the development of research, training and evaluation programs

(11) to provide sufficient detail to permit consideration of the appropriate procedures for all regions of Canada, for implementation by the private sector and for the development of possible national standards for audit procedures

(12) to provide a design which will be open to state-of the-art developments in auditing tools and techniques

(13) to provide a procedure adaptable to the wide range of homes to be encountered by advisers

(14) to provide a modular procedure in which sub-routines can easily be amended, updated, added, reduced or enhanced

(15) to provide a procedure which can be delivered by one adviser but which is adaptable to two person or two-step approaches for test purposes

(16) to provide a procedure which is immediately applicable to PEI but which can be easily transferred to other regions since the procedure will be modified for use in other ECAP regions

(17) to provide a procedure which in the interest of flexibility and cost is adaptable to manual, hand-held computer or on-site terminal calculations

(18) to provide a procedure which is within the capability of a "college level" technician with 3 weeks special training

3. SUMMARY OF THE ENERGY SURVEY RECOMMENDATIONS

After careful consideration of the range of energy conservation measures which could reasonably be dealt with in a 2½ hour audit, the draft energy survey procedure was designed to cover the set of recommendations summarized in Table 1. The table lists the potential recommendations which apply to each main area of on-site analysis and specifies the following factors for each recommendation:

(1) Requirements - The pre-requisites which must be met before the adviser makes the recommendation.

(2) Cost Components - The specific product types upon which the estimated costs to carry out each recommendation are based. Cost factors based on regional prices for these components (do-it-yourself and contractor installed) will be pre-entered on the data forms for the adviser's easy reference in developing cost estimates.

(3) Savings Calculation - A summary of the basic approach used to determine estimated savings. Potential savings are generally calculated as a percentage of the projected heating cost for the next heating season.

NOTES: (1) Cost and savings estimates are calculated independently for each measure. Only measures with a simple payback (costs/annual savings)of less than 10 years are recommended.

(2) Wood and solar assessment sub-routines have not yet been developed. Since these items are covered by the ECAP grant, it will be necessary to use the field tests to determine the appropriate degree of analysis for these measures if the householder requests advice.

TABLE 1

SUMMARY OF ECAP ENERGY SURVEY RECOMMENDATIONS

AREA	RECOMMENDATION	REQUIREMENT	COST COMPONENTS	SAVINGS CALCULATION
SEALING	WEATHERSTRIP DOORS	INADEQUATE CAULK AND WEATHER-STRIPPING ON AT LEAST 50% OF DOORS	DOOR WEATHERSTRIPPING KIT (STANDARD 2 SQ. METRE DOOR)	5% OF AIR CHANGE LOSSES
	WEATHERSTRIP WINDOWS	INADEQUATE CAULK AND WEATHER-STRIPPING ON AT LEAST 50% OF WINDOWS	WINDOW WEATHERSTRIPPING (STANDARD 1 SQ. METRE WINDOW)	15% OF AIR CHANGE LOSSES
	SEAL BUILDING ENVELOPE	ATTIC FOUNDATION OR WALL AREAS LEAKY & FULLY ACCESSIBLE TO SEA	BASED ON AVERAGE COSTS FOR TYPICAL ATTIC FDN OR WALL JOBS	20% OF AIR CHANGE LOSSES
THERMOSTAT SETBACK	SET AT 20°C DAY AND 17° NIGHT	CURRENT SETTINGS ABOVE 20°C DAYTIME AND/OR ABOVE 17°C NIGHT TIME	1 AUTOMATIC SETBACK DEVICE 1 HOUR OF LABOUR (IF APPLICABLE)	FROM SAVINGS TABLE DEPENDING ON REGIONAL WINTER TEMPERATURES
DOMESTIC HOT WATER	INSTALL FLOW RESTRICTOR KIT	. NO RESTRICTORS IN PLACE . SHOWERHEAD AND BATHROOM AND KITCHEN FAUCETS MUST BE THREADED & USED REGULARLY . SHOWER FLOW RATE MORE THAN 3 GAL/MIN	1 FLOW RESTRICTOR KIT CONTAINING 1 LOW FLOW SHOWER-HEAD & 2 FAUCET FLOW RESTRICTORS FOR BATHROOM & KITCHEN FAUCETS	50% OF SHOWER DHW USE OR 15% OF DHW COSTS
	REDUCE THERMOSTAT TO 120°F	. MEASURED DHW TEMP ABOVE 120°F	NIL	FROM THERMOSTAT SETBACK SAVINGS TABLE DEPENDING ON CURRENT WATER TEMP. AND LEVEL OF INSULATION AND TYPE OF FUEL
	INCREASE TANK INSULATION TO RSI 3.5	. CURRENTLY 50 MM OF INSULATION OR LESS . MORE THAN 2 YRS. FURTHER LIFE . MORE THAN 50 MM TANK CLEARANCE . ROOM CANNOT BENEFIT FROM STANDBY LOSSES	GLASS FIBRE BATTS (100 OR 150 MM) FOIL COVERING FASTENERS	FROM TANK INSULATION SAVINGS TABLE DEPENDING ON LEVEL OF INSULATION AND TYPE OF FUEL AND ASSUMING SETBACK TO 120°F

AREA	RECOMMENDATION	REQUIREMENT	COST COMPONENTS	SAVINGS CALCULATION
OIL HEATING SYSTEM	HAVE FURNACE SERVICED	NO SERVICING WITHIN YEAR OR MAINTENANCE REQUIRED	TYPICAL SERVICE CHARGE	5% OF PROJECTED OIL HEATING COSTS
	HAVE FURNACE TUNED	NOT TUNED I.E. SMOKE TEST OUTSIDE 2 TO 3 RANGE OR DRAFT OUTSIDE .03 TO .05 RANGE	TYPICAL TUNING CHARGE	5% OF PROJECTED OIL HEATING COSTS
	INSTALL SOLENOID VALVE	NO SOLENOID VALVE OR CLUTCH COUPLING SYSTEM	SOLENOID VALVE LABOUR	3% OF PROJECTED OIL HEATING COSTS
	INSTALL CIRCULATING PUMP	NO CIRCULATING PUMP	CIRCULATING PUMP LABOUR	25% OF PROJECTED OIL HEATING COSTS
	REDUCE FAN SETTINGS TO 120°F and 90°F	CIRCULATING FAN TEMP. SETTINGS ABOVE 120°F CUT-OUT AND 90°F CUT-IN	NIL	5% OF PROJECTED OIL HEATING COSTS
	DOWNSIZE NOZZLE (IN ASSOCIATION WITH RETROFIT)	.PROPER SIZE GIVEN BY NOZZLE SIZE CHART DEPENDING ON STEADY STATE EFFICIENCY AND DESIGN HEAT LOAD .DOWNSIZING LIMITED BY STACK TEMP. CHART	1 NOZZLE UNIT AT SERVICING	ABOUT 1.3% OF PROJECTED OIL HEATING COST FOR EACH PERCENT OVERSIZED
	DOWNSIZE NOZZLE (WITHOUT RETROFIT RECOMMENDATION)	. SIZE NO LESS THAN ONE BELOW CSA MINIMUM . OTHER FACTORS AS FOR RETROFIT	1 NOZZLE UNIT AT SERVICING	3% OF PROJECTED OIL HEATING COSTS
	INSTALL RETENTION HEAD KIT	. CONVENTIONAL BURNER WITHOUT RETENTION HEAD . LESS THAN 16 YRS OF AGE . LESS THAN 75% EFFICIENCY IF TUNED . LESS THAN 68% EFFICIENCY IF NOT TUNED . CSA APPROVED KIT AVAILABLE	. RETENTION HEAD KIT . CERAMIC LINER (IF NECESSARY) . LABOUR	FROM RETENTION HEAD OR NEW BURNER SAVINGS TABLE WHICH ASSUMES 80% FINAL EFFICIENCY AND IS BASED ON: $\frac{80\% - E\ \text{initial}}{80\%} \times 100$
	REPLACE BURNER (WITH ENERGY EFFICIENT BURNER)	. SAME AS ABOVE EXCEPT NO CSA APPROVED RETROFIT KIT AVAILABLE	. BURNER KIT . LABOUR	AS ABOVE

AREA	RECOMMENDATION	REQUIREMENT	COST COMPONENTS		SAVINGS CALCULATIONS
			DO-IT-YOURSELF	CONTRACTOR (PLUS LABOR CHG)	
WINDOWS AND DOORS	INSTALL STORM WINDOWS INSTALL THERMAL DOORS	ALL SINGLE PANE WINDOWS ALL REGULAR DOORS	METAL FRAME STORM WINDOW 50 MM DOOR PLUS FRAME (URETHANE CORE)	SAME AS DO-IT YOURSELF	ALL SAVINGS ARE CALCULATED USING THE BUILDING ENVELOPE WORKSHEET (MODIFIED NRC METHOD)
FOUNDATION	INSULATE CRAWL SPACE TO RSI 2.1	NO EXISTING INSULATION NO MOISTURE PROBLEMS	. RSI 2.1 GLASS FIBRE BATTS . 6 MIL POLY VAPOUR BARRIER	SAME AS DO-IT YOURSELF	
	INSULATE FOUNDATION WALL TO RSI 2.1 (TOP TO BOTTOM)	AS ABOVE	. RSI 2.1 GLASS FIBRE BATTS . 6 MIL POLY VAPOUR BARRIER . 2"X4"X8'STUDS	SAME AS DO-IT YOURSELF	
	INSULATE SLAB ON GRADE TO RSI 2.1	AS ABOVE PLUS EASY ACCESS TO SLAB	. RSI 1.8 EXTRUDED POLYSTYRENE (2'X8'X2" BOARD) . 40 KG BAG MASONRY CEMENT . EXPANDED METAL LATHE	SAME AS DO-IT YOURSELF	
MAIN ATTIC	INCREASE INSULATION LEVEL TO RSI 5.6	LEVEL OF INSULATION 70% BELOW RECOMMENDED AMT. NO MOISTURE PROBLEMS	. GLASS FIBRE BATTS (RSI 1.4, 1.8, 3.5, 4.9, AVERAGED)	RSI 5.6 BLOWN CELLULOSE	
SIDE ATTIC	INCREASE FLOOR INSULATION TO RSI 5.6	AS ABOVE	AS ABOVE	AS ABOVE	
	INCREASE KNEE WALL AND RAFTER INSULATION TO RSI 2.1	NO EXISTING INSULATION NO MOISTURE PROBLEMS	. RSI 2.1 GLASS FIBRE BATT	SAME AS DO-IT YOURSELF	
ROOF	INSULATE TO RSI 3.5	NO EXISTING INSULATION NO MOISTURE PROBLEMS	NOT RECOMMENDED	RSI 3.5 BLOWN CELLULOSE	
EXPOSED FLOOR	INSULATE TO RSI 4.9	NO EXISTING INSULATION NO MOISTURE PROBLEMS	. RSI 4.9 GLASS FIBRE BATT . 6 MIL POLY VAPOUR BARRIER (10' x 150' ROLL)	RSI 4.9 BLOWN CELLULOSE	
MAIN WALL	INSULATE TO RSI 2.1	NO EXISTING INSULATION NO MOISTURE PROBLEMS	NOT RECOMMENDED	RSI 2.1 BLOWN CELLULOSE	

NOTE: INSULATION COST COMPONENTS ARE TAKEN DIRECTLY FROM THE ENERSAVE "CLASS B" COST SYSTEM

4. SUMMARY OF BASIC PROCEDURE

In designing the energy survey, considerable effort has been made to structure a procedure which provides meaningful results to the householder but which does not overtax the adviser in terms of duration and complexity of analysis. To conduct the survey, the adviser follows the procedures for client interview, building dimensioning and inspection, and cost and saving calculations that are specified on the five inspection forms (Appendix 1) making use of the adviser's reference tables where necessary (Appendix 2).

The objective of the inspection design is to provide the adviser with sufficient information to determine:

(1) the estimated annual heating fuel and domestic hot water consumption and costs as a basis for savings estimates
(2) the area and RSI-values of all components of the building envelope and an estimated air change rate to determine a total building heat load via the building envelope worksheet
(3) the estimated amount of "free heat" in the building to adjust savings estimates for the increasing proportion of free heat after retrofit
(4) the suitability of the building envelope for sealing and insulation measures and of the DHW and oil heating systems for retrofit or thermostat setback
(5) the requirements for maintenance work to ensure the effectiveness of any recommended fuel-saving measures

After these determinations have been made the adviser uses the calculation worksheets to develop a set of recommended actions with estimated costs and savings. The survey recommendations together with any necessary maintenance requirements are then entered on the results form and discussed with the householder.

The following summary provides a step-by-step description of the basic procedure as it has been designed for field test purposes. The following elements of the procedure are covered:

1. Appointment Arrangement
2. Equipment Preparation
3. Arrival
4. Residence Identification
5. Client Interview
6. Projected Fuel Consumption Estimate
7. Building Dimensions
8. Door and Window Inspection
9. Thermostat SetBack Inspection
10. Domestic Hot Water Inspection
11. Heating System Inspection
12. Building Envelope Inspection
13. Presentation of Results

1. Appointment Arrangement

The householder is contacted by phone and a convenient meeting time is arranged. The purpose of the consultation is explained and any general questions the householder may have are answered. The householder should be reminded to have fuel records ready for the adviser if possible.

2. Equipment Preparation

The adviser leaves to conduct the consultation with a clipboard containing the energy survey forms which will guide all aspects of inspection, data collection and calculations and an adviser's tool kit consisting of the following:

ADVISER'S TOOL KIT

. tape measure (calibrated in metres)	to measure building components
. digital thermometer	to measure indoor temperature and hot water temperature
. flashlight	for attic inspection
. ladder	for entry to attic
. smoke pencils (Draeger air current tester)	to identify and demonstrate air leakage sites
. wall inspection kit (drill, light, cork, sealant)	to determine amount and type of insulation in wall cavity
. furnace efficiency kit	to measure stack temperature, CO_2 level, smoke and draft levels
. programmable calculator	to conduct calculations

(3) Arrival - The adviser arrives on-site as scheduled. The adviser greets the householder, introduces himself, and presents a business card or other suitable ID. The adviser then explains the purpose of the consultation, outlines the basic procedure and how much time it will take and answers any general questions.

(4) Residence Identification - For reference purposes, the adviser enters the age, number of storeys, wall construction and foundation type of the home.

(5) Client Interview - To obtain key data for use in the calculation procedure, the adviser interviews the householder to

determine:

(a) Number of residents - for DHW and free heat estimates

(b) Thermostat settings - for day, evening and night setback savings

(c) Daily DHW use per person - for DHW costs determination

(d) Basement Temperature (20,17 and 15°C levels) - for basement RSI adjustment

(e) Moisture Production Level - for air change estimate

    (i) Resident Level
    (ii) Basement Humidity
    (iii) Dryer Venting
    (iv) Winter Humidifier Use

(f) Humidity Level - for air change estimate

(g) Air Change Estimate - correlation of moisture production and humidity level

(h) Exposure Factor - air change estimate adjustment for exposure to wind (if applicable)

(i) Reinsulation History - orients building inspection

(j) Current Problems - orients building inspection

6. Projected Fuel Consumption Estimate

The adviser asks the householder to present fuel oil consumption records for the past year. If these are available the detailed fuel oil consumption calculation linking consumption to degree-days is carried out. If not, then the adviser asks the householder for a best estimate of last year's costs. If supplementary heating systems are used, these costs must be estimated as well.

Using fuel price escalation and degree-day normalization factors, a projected heating cost for the next heating season is calculated. If space heating and hot water heating rely on the same fuel, a hot water correction (to be ascertained during the inspection] must be applied later.

7. Building Dimensions

The adviser explains that the home inspection section of the energy survey will begin with an exterior inspection to determine component dimensions and to check for any exterior maintenance problems.

The adviser then goes outside the home and in sequence draws the front, right, rear and left views of the building noting the basic height and width of each building face, the size and type of windows and doors, and the amount of foundation exposed above grade. A first floor plan view is sketched and perimeter dimensions are entered.

Finally any maintenance problems observed during the exterior inspection are noted and recorded on the adjacent envelope inspection form.

NOTE: A detailed area and RSI work sheet has been provided to allow the adviser to calculate these values with direct reference to the building sketch. The RSI values for various standard assemblies will be provided in the reference tables to be carried by the adviser. Buffered areas, next to unheated rooms are noted so that a correction factor can be applied to the RSI value (if possible).

All dimensions are entered in metres.

Window areas are not measured. Instead windows are classed as small, medium or large and assigned an area of .5 metres, 1.0 metres and 1.5 metres respectively. A standard door area of 2.0 metres is assumed for all doors.

Patio doors count as 2 windows. Basement windows are not counted on the door and window worksheet.

8. Door and Window Inspection

Using the door and window worksheet, the adviser enters the home and inspects the home's doors and windows to determine the number of each which require weatherstripping.

9. Thermostat Setback Inspection

(a) To determine the accuracy of the thermostat, the adviser measures the indoor temperature and then turns the setting upward until the furnace turns on and records the thermostat reading (with a one °F downward correction for anticipation). If the thermostat reading is in error, a correction factor is entered.

(b) The adviser notes if an automatic setback device is already in use.

(c) The adviser checks off the current thermostat settings (corrected for error) on the appropriate daytime and night-time setback scales. The percent savings for each period are added to develop a total percent savings factor.

NOTE: If the householder's day and evening settings are different, the adviser circles both settings on the daytime scale and then obtains an average value for the daytime period.

10. Domestic Hot Water Inspection

(a) The adviser first measures the current hot water temperature to determine potential for savings by reducing to 120°F.

(b) To assess suitability for installation of flow restrictors (1 showerhead and 2 faucet restrictors) the adviser checks to see if the showerhead and faucets are adaptable to restrictors.

(c) To determine the feasibility of adding tank insulation and the potential savings, the adviser enters the type of system, the tank capacity, the amount of current insulation , and determines if the tank meets the insulation requirement of having more than two years lifetime and more than 50 mm of clearance for insulating.

11. Heating System Inspection (Oil Systems Only)

(a) The adviser completes the maintenance flag section of the form noting possible repair or adjustment requirements where applicable.

(b) To determine suitability for downsizing, or retrofit options the adviser enters the type, manufacturer and age for both the furnace and/or boiler and burner. The rated BTU specs. the minimum nozzle spec, the actual nozzle size and absence or presence of a solenoid valve are also entered.

(c) To determine whether fan temperature should be reduced (forced air systems) or a circulating pump installed (hydronic systems), the adviser notes whether there is continuous fan operation and the current temperature settings for forced air systems or whether there is a circulating pump and if so whether there is continuous operation and a variable aquastat for hydronic systems.

(d) The adviser inspects the duct or pipe system in the basement and determines if any of the maintenance flags are applicable.

(e) The adviser completes basic efficiency and tuning tests.

12. Building Envelope Inspection

The adviser works through the building envelope inspection form starting from the foundation, then moving to the roof areas and finishing with wall and floor areas. For each component area, the adviser notes:

(a) component structure - for RSI determination

(b) amount of existing insulation - for RSI determination

(c) sealing requirement (if unsealed and accessible) - for sealing estimate

(d) access to wall cavity (if applicable) - for determining optimum approach to adding insulation

(e) maintenance flags (as specified on form) - for advice to householder

NOTE: The attic ventilation worksheet is used to determine if additional ventilation should be installed for only those attics which have evident moisture problems. The calculations are based on a desirable vent to attic area ratio of 1:300 for soffit systems and 1:150 for less efficient non-soffit systems.

13. Calculations

Having completed all inspection details on each form, the adviser asks the householder for permission to use a kitchen or dining room table to carry out cost, savings, and payback calculations for each eligible measure. (Eligibility is determined on the basis of pre-requisites specified in Table 1).

The calculations are completed as specified on the building enveloper chart (for sealing and insulation measures) and the worksheets provided on the thermostat, DHW and oil heating forms. The reference tables are used to determine RSI-values, air change heat loss, optimum nozzle size and suitablility of the heating system for retention head retrofit. Pre-entered cost factors are used to develop cost estimates. An explanation of the calculations methodology is provided in Part 5.

14. Presentation of Results

Following the completion of all calculations the adviser summarizes the applicable recommendations and maintenance flags on the results presentation form and completes any comments or payback calculations. The recommendations are then roughly priorized. Since the results form is roughly organized in terms of appropriate sequence of implementation, the adviser first priorizes all recommendations with a payback shorter than 5 years by proceeding down the chart. The priorization process is then repeated for paybacks of less than 10 years. Measures with payback of more than 10 years are not recommended.

The adviser explains the priorized list of actions to the householder outlining the cost, the savings and any associated maintenance work. Time constraints mean that maintenance work will not be costed however it may be possible to leave a list of contractors from whom estimates could be obtained.

Following presentation of the results, the adviser leaves an energy survey information brochure (Appendix 3) which explains all the measures covered by the survey. In addition to the introductory brochure, householders will also receive the main EMR "How To" publications Keeping the Heat In and The Billpayers Guide To Furnace Servicing, specific fact sheets on technical issues related to the householder's requirements, and referral information for national, regional and local agencies which could provide useful follow-up assistance and advice (e.g. Heatline, regional CREB office, energy survey office, provincial programs, certified contractors).

NOTE: The current results presentation form and supporting materials are intended for development purposes only. A more polished package should be prepared for the delivery of the pilot program. An effective package is vital to the success of the energy survey.

The adviser spends the remaining time answering questions the householder may have about implementing the recommended measures. The adviser terminates the energy survey by thanking the householder for their interest in energy conservation and offering encouragement to follow through on the recommended measures by emphasizing their benefits.

5. SUMMARY OF CALCULATION METHODOLOGY

This section provides a brief explanation of the methodology and assumptions underlying the calculation worksheets, cost factors, and reference tables which have been directly integrated within the inspection forms.

A. SEALING AND INSULATION MEASURES

1. Projected Fuel Cost Estimate

(a) General Approach

The projected fuel cost is based on a determination of the fuel oil consumption per degree-day during the past heating season. This value is then normalized for average weather conditions by multiplying by the average number of degree-days in the region to develop an annual fuel consumption estimate. The projected fuel cost is then determined by multiplying by the estimated cost of fuel on the first December 31 following the date of the audit. The use of a projected fuel cost is designed to orient the householder to the increased fuel costs that will have to be faced in the coming heating season if no action is taken. Projected prices will be based on the revised NEP fuel escalation rates and the present rate of inflation.

NOTE: A hot water correction must be applied in cases where the same fuel is used for space and water heating. Since the heating season is assumed to be 7 months, this is simply a question of subtracting 7/12 (60%) of the projected hot water cost estimate determined during the DHW inspection.

Since tankless coils systems can reasonably be assumed to be twice as efficient during the 7 month winter heating season as in the summer, costs in each summer month are about twice those in winter months (assuming constant consumption). This means that for tankless systems, the DHW correction is 7/17 (40%) of the projected hot water cost estimate.

The use of an estimate based on actual fuel consumption is considered to be easier, more accurate and more credible than basing costs on theoretical heat loss coefficients. It also eliminates the need to consider such variables as lifestyle, orientation, exposure, etc. and permits the fuel bill to be estimated prior to the on-site inspection.

(b) Projected Fuel Costs (If No Records Available)

If the householder has no fuel records available, the adviser must proceed on the basis of the householder's estimate of last year's fuel costs. This value is then normalized by a degree-day factor (average degree-days divided by last year's degree-days).

While subject to inaccuracies, this method at least structures the audit around what the householder perceives his fuel costs to be. Savings estimates will be accurate to the extent the householder's perception is accurate. If a rough estimate must be made it is probably desirable that the responsibility is born by the householder rather than the adviser.

In the case of auxiliary electric or wood systems, it is probable that there will be little alternative but to trust the householder's estimate of costs (hopefully based on some form of records).

(c) Detailed Oil Heating Cost Estimate (If Records Available)

If the householder can supply adequate fuel oil records, the adviser lists the dates and amounts of all fill-ups on the detailed estimation chart. The dates and amounts of at least two consecutive fill-ups are required although a minimum of four fill-ups is desirable to ensure accuracy. To avoid distortion due to irregular heating during the early and late months of the heating season the fill-up dates should fall between November 1 and March 1.

The adviser develops a fuel consumption per degree-day estimate by totalling fuel consumption between two reference dates (using the first fill-up as a zero reference) and using the degree-day chart provided in the refernce tables., which provides degree-day figures for all dates in the heating season. The heating season is assumed to be September 15 to April 15. (Weather office data suggest that variations in the length of this season of up to one month will affect fuel cost estimates by less than 2% in regions with more than 4000 degree-days per year).

An average fuel consumption estimate is developed by multiplying by the average degree-days in the region. A projected fuel cost can then be determined by multiplying by the projected fuel price.

B. BUILDING HEAT LOAD ESTIMATE

(1) Building Envelope Worksheet

The worksheet is designed to guide the adviser through the cost and savings calculations required for insulation and sealing measures. It is a modified version of the well-known NRC savings estimation procedure and the main steps in the calculations are clearly shown on the chart. Both manual and computer aided calculation approaches can be used.

For each component area (A) and current RSI-values (R_1) are entered and a heat flow value (C) calculated. The total heat flow for conductive losses (C_T) for all components is then totaled.

The total heat flow for air change losses (AC_T) is estimated using the reference table designed for this purpose. The table provides heat flow values for various combinations of air change rate and building envelope areas for both standard and irregular envelope shapes (methodology described below). To use the table to determine air change heat loss, the adviser first sums the areas of all components to develop a total envelope area (A_T) and enters this value and the air change rate estimated in the client interview on the building envelope chart. With these values, the air change heat loss can be read directly from the table.

Total heating load (H_T) is then calculated ($C_T + AC_T$). Percent heat flow (P) through each component including air change is then calculated by dividing each individual heat flow rate by the total heating load.

The projected heating cost EC (corrected if necessary for domestic hot water costs) is entered on the chart. To account for free heat in savings calculations, the projected heating cost is adjusted upwards by multiplying by the appropriate free heat factor for the particular type of residence. The free heat factor is determined by rating the home in terms of solar exposure and occupancy and reading the factor for the particular rating level from the free heat correction factor table which provides pre-calculated factors for various levels of total heat loss. The free heat factor and the resulting adjusted heating cost (HC_A) are then entered on the chart.

Percent savings for each component are calculated using the formulae shown on the chart. The dollar savings are calculated by multiplying the adjusted heating cost (HC_A) by the appropriate saving.

Savings estimates for sealing measures are calculated separately. Weather stripping estimates for doors and windows are based on assumed maximum savings of 5 and 15% of the air change heat loss component of the adjusted heating cost. If only 50-80% of the doors or windows require weatherstripping, the savings are reduced to 3 and 10% respectively. No savings are calculated if less than 50% of doors or windows require weatherstripping.

The savings estimates from caulking or sealing the wall, foundation, and attic components of the building envelope are based on an assumed saving of 10% of the air change heat loss for each component area considered leaky and accessible to seal (i.e. a maximum savings of 30% for all three areas.)

(2) Air Change Rate Estimate

The air change rate (ACR) is estimated during the client interview by separately rating the amount of moisture production and the level of humidity in the home. Moisture then operates as a "tracer gas" for the air change determination so that, for example, homes with high moisture production levels but low humidity can be assumed to have maximal leakage. The air change values in the estimation tables are based on Scanada data and have been adjusted for the PEI housing stock. An exposure correction factor of 1.5 is applied for homes with high wind exposure.

NOTE: If the adviser notes high humidity levels or high moisture production in the home, a maintenance flag recommending that humidity levels be reduced will be provided to the householder to avoid moisture problems after insulating.

(3) Air Change Heat Loss Table

To calculate air change losses (AC_T) in W°/C, the following formula was used:

$$AC_T = \frac{ACR \times V \times SH}{3600 \text{ sec/hr}} \qquad (1a)$$

where

ACR = estimated no. of air changes per hour
V = volume of the conditioned area of the home
SH = energy required to increase the temperature of 1 cubic metre of air by 1°C (.361 joules)

Using equation (1), the air change heat loss calculation table was developed for a range of volumes and air change rates. Since the adviser can quickly determine total envelope area by adding the areas on the chart, the table correlates envelope areas to conditioned volumes for different classes of residences to enable rapid determination of the air change heat loss. The correlation is based on the following equation:

$$V = \left[\frac{A}{6 \times I}\right]^{1.5} \qquad (1b)$$

where

V = conditioned volume
A = envelope area
6 = number of sides to a cube
I = residence envelope area index (equals 1 for a perfect cube)

The values of I developed for different residence classes are shown below. Due to the similarity in values between standard homes (all storey) and the irregular shaped homes, it was decided to assume a value of 1.06 for all standard homes and of 1.18 for irregular shapes.

RESIDENCE ENVELOPE AREA INDICES

Standard 1 storey (bungalow)	1.07
Standard 1 ½ storey	1.09
Standard 2 storey	1.02
Standard 2 ½ storey	1.06
L-shaped 1 storey	1.22
L-shaped 2 storey	1.14
Split level	1.17
2 storey plus 1 story addition	1.20

4. Free Heat Correction Factor Table

Free heat correction factors have been developed for three clases of home as rated by the amount of solar exposure (free solar gain) and the number of residents (free heat from residents, and light and appliance use). For the three rating levels shown on the free heat table (building envelope chart) it is assumed that free heat contributed 18, 26 and 39 GJ respectively (based on Scanada data). This contribution was calculated as a percentage of total heating load for the range of values shown in the table. The conversion from W/°C to GJ was achieved by multiplying the heating load values in W/°C by the regional degree-day value in degree-sec. The free heat correction factor (FHCF) is given by:

$$\text{FHCF} = \frac{1}{1 - \text{FH}/H_T} \qquad (2)$$

where

FH = free heat contribution in GJ (18, 26 or 39)
H_T = total heating load in GJ

P. THERMOSTAT SETBACK

The thermostat setback savings can be calculated as a percentage of the adjusted heating cost (corrected for free heat) since the thermostat savings reduce the total gross heating requirement. The savings factors shown on the form must be adjusted for each region since the same amount of setback will represent a higher proportion of total heat rise in warmer regions and conversely a lower proportion in colder regions.

The average percent savings per degree of thermostat setback are given by:

$$PSD = \frac{1}{T_1 - T_2} \times \frac{A}{C} \times 100 \qquad (3a)$$

$$PSN = \frac{1}{T_1 - T_3} \times \frac{B}{C} \times 100 \qquad (3b)$$

$$TPS = PSD \times (T_D - 68) + PSN \times (T_N - 63) \qquad (3c)$$

where

PSD = percent savings per °F of day setback (16 hr)
PSN = percent savings per °F of night setback (8 hr)
TPS = total percent savings
T_1 = assumed average indoor temperature
T_2 = average day time winter temperature in region
T_3 = average night time winter temperature in region
T_D = current day time setting
68 = recommended day time setting
T_N = current night time setting
63 = recommended night time setting
A = 16 hours (the assumed length of day setting)
B = 8 hours (the assumed length of night setting)
C = 24 hours (total daily hours)

The completed savings table shown on the inspection chart are based on average day and night winter temperatures in Ottawa. The tables show pre-calculated day and night savings for various possible current settings assuming setback to 68°F during the day and 63°F during the night. (If day and evening settings are different, the adviser circles both values and uses the average of the percent savings values).

If the accuracy check on the thermostat during the inspection shows that it is reading high or low, the appropriate correction must be applied to the reported settings before using the savings table.

Total percent savings are determined by adding the values shown in the tables for day and night setback. (See equation 3c).

C. DOMESTIC HOT WATER MEASURES

(1) Daily Consumption Estimates

The domestic hot water system poses special problems since total consumption (and hence costs) are very difficult to estimate. The ECAP DHW procedure is based on the following general estimates of daily hot water consumption per person which have been derived from the 1981 IBI report, "Hot Water Load Profile Study", for the Solar Energy Project, National Research Council:

general purpose	-	20 litres (or 45 litres if shower/bath use not known)
washing machine (hot cycle only)	-	additional 15 litres
dishwasher	-	additional 10 litres
showers	-	additional 7 litres per shower/week
baths	-	additional 9 litres per bath/week

(2) Annual DHW Cost Estimates

Pre-calculated tables and cost factors are provided to assist the adviser in completing the DHW cost worksheet. Costs are calculated by adding the replacement costs (R) for various levels of consumption plus basic standby loss costs (SB) which do not vary with consumption. Total costs are then given by R + SB.

(3) Replacement Costs

The replacement costs refer to the cost of heating cold water to replace hot water drawn off for use and are given by:

$$R = P \times N \times F \times T \qquad (4)$$

where

P = daily use per person
N = number of residents
F = replacement cost factor (costs per person per litre)
T = heating factor correction for temperature

(4) Replacement Cost Factor

The replacement cost factor, F, is given by:

$$F = \frac{J_1 \times 365 \times (T_T - T_E) \times FP}{J_2 \times SE} \qquad (5)$$

where

J_1 = no. of joules required to raise 1 litre of water through 1°C (4187 joules)
365 = no. of days per year
T_T = typical factory temperature setting for DHW tank (70°C or 160°F)
T_E = typical ground temperature (5°C)
FP = projected cost of fuel per unit
J_2 = no. of joules per unit of fuel
SE = seasonal efficiency of the system (100% electric, 55% oil)

Therefore, for oil systems assuming 55% efficiency, the replacement cost factor is given by:

F_{oil} = 4.66 X oil price per litre in dollars

NOTE: Tankless coil systems are also assumed to have an average efficiency of 55% (i.e. 70% in the 7 month heating season, 35% in summer).

For electric systems at 100% efficiency, the replacement cost factor is given by:

$F_{electric}$ = 27.59 X electricity price per kwh in dollars

Since the replacement cost factor is calculated assuming a tank temperature of 160°F or 70°C, the appropriate temperature correction factor (T) shown on the DHW worksheet are used by the adviser to account for the change in F, for varying values of T_T in equation (5) as determined by the actual measured hot water temperature.

(5) Standby Loss Cost Factor

A considerable amount of heat is lost through the walls of the tank as the hot water remains on "standby" for use. The standby loss cost factor (SF) for each type of fuel are calculated using the following formula:

$$SB = \frac{U \text{ X } A \text{ X } B \text{ X } FP \text{ X } (T_T - T_R)}{J_2 \text{ X } SE} \qquad (6)$$

where

U = heat loss coefficient of tank wall
(5.68 W/°C for no insulation
1.42 W/°C for 25 mm insulation
.81 W/°C for 50 mm insulation)
A = typical area of water tank
(1.72 M^2 for 25 gal. tank
2.44 M^2 for 40 gal. tank
4.32 M^2 for 60 gal. tank)
B = no. of seconds per year ($31.536 \text{ X } 10^6$)
FP = projected cost of fuel per unit
T_R = cool room temperature (17°)
T_T = assumed tank temperature (70°C)
J_2 = no. of joules per unit of fuel
SE = seasonal efficiency of the system (as above)

Since the standby loss cost factor is calculated assuming a tank temperature of 160°F (70°C) the appropriate temperature correction factor (T) shown on the DHW worksheet is used by the adviser to account for the change in SF for varying levels of T_T in equation (6) as determined by the actual measured hot water temperature.

(6) DHW Temperature Setback

The temperature savings factor for DHW temperature setback are calculated by determining the reduction in replacement and standby costs when T_T in equations (5) and (6) respectively is reduced from 160, 150, 140, or 130°F to 120°F. The percent reduction in replacement and standby costs is comparable so that the setback factor shown on the DHW worksheet applies equally to both replacement and standby costs and consequently can be applied directly to the total DHW cost estimate, as indicated on the worksheet.

(7) Flow Restrictor Savings

Based on data published in the June 1981 University of Waterloo Working Paper No. 3 by Robinson, it is assumed that 50% of consumption can be saved by the installation of flow restrictors. (The savings on individual faucets are assumed to be negligible in comparison). Consequently total flow restrictor savings are given by:

$$FRS = 50\% \times \frac{S}{P} \times C \qquad (7)$$

where

S = shower use consumption daily
P = total daily consumption
C = total DHW costs

If shower use is not known, shower use is assumed to be 1/3 of total consumption and savings therefore are assumed to be 1/6 or 15% of total cost.

(8) DHW Tank Insulation

The savings table for insulation savings was calculated using equation (5) and substituting the change in the heat loss co-efficient of the tank (U) due to adding insulation for the basic co-efficient (U). The recommendation calls for tank insulation to be increased to RSI 3.5 which corresponds to a final U - value of .28. For tanks with no insulation, the initial U - value is 5.68. Tanks with 25 or 50 mm of insulation are taken together (since there is little difference in savings) assuming 33 mm of insulation or an initial U - value of 1.1

It is assumed that tank insulation is applied after water temperature (T_T) has been reduced to 120°F in equation (5) so as to avoid double-counting setback and insulation savings.

D. OIL HEATING SYSTEM MEASURES

(1) Tuning

The tuning recommendation requires the householder to have a qualified serviceman perform an instrumented tuning of heating system to ensure minimum air flow (i.e. a smoke no. between 2 and 3 and a properly leveled and balanced barometric damper with draft between .03 and .05). A savings of 5% of the projected oil heating cost has been assigned to this measure based on CCRL field data.

(2) Delayed Action Solenoid Valve

A delayed action solenoid valve is recommended for units which do not have a solenoid or clutch coupling system. A savings estimate of 3% of the projected oil heating cost is based on CCRL field data.

(3) Servicing

Servicing is recommended for units which have obvious maintenance requirements or which have not been serviced within the last year. The savings estimate of 5% is based on a comprehensive servicing job based on a thorough inspection, safety check, lubrication and cleaning of the system and repair of any maintenance measures noted by the adviser (e.g. sealing all excess air leaks into the combustion chamber, cleaning fan blades, taping duct joints).

(4) Circulation Pump (Hydronic Systems Only)

A circulating pump will be recommended for hydronic systems which are not already equipped with a pump. The savings estimate of 25% of the projected oil heating cost is based on CCRL field data.

(5) Fan Settings (Forced Air Systems Only)

The savings for reducing fan settings to 120^0F and 90^0F are assumed to be 4% of the projected oil heating cost. This estimate which is felt to be conservative is based on the following assumptions:

(i) average furnace on-time is 10 minutes or less
(ii) average fan temperature settings are 150^0F and 120^0F
(iii) the heat exchanger functions within 50% of normal efficiency as the furnace plenum temperature drops from 120^0F to 90^0F
(iv) heat loss up the chimney accounts for only 50% of the deliverable heat when the fan has stopped functioning
(v) the prescribed reduction in temperature settings should have no effect on building heat losses or comfort
(vi) lowered settings increase average on-time to 13 minutes

(vii) an assumed 30% increase in on-time (10-13 minutes), a 50% reduction in heat exchanger efficiency at lower temperatures, and a 50% heat recovery without fan assistance gives a possible saving of 7.5%, (i.e. .3 X .5 X .5 X 100)

(viii) the actual savings can be expected to be at least 50% of possible savings, resulting in a conservative savings estimate of 4%.

(6) Retention Head or New Burner

The savings calculation for both retrofit options are based on the following assumptions:

(i) overall combustion efficiency improvements of up to 15% are reasonable (see results of PEI retrofit program)

(ii) combustion efficiency increases translate directly into overall seasonal efficiency improvements

(iii) final efficiency after installation should be about 80%

Given these assumptions, savings can be calculated as follows:

$$PS = \frac{E_f - E_i}{E_f} \qquad (8)$$

where

PS = percent savings (no greater than 15%)
E_f = final steady-state efficiency (80%)
E_i = initial steady-state efficiency

(7) New Unit

Assuming the installation of a new unit which provides at least 80% steady-state efficiency, equation (10) can also be used to calculate savings from unit replacement.

(8) Nozzle Downsizing

If retrofit installation is recommended, it is assumed that it will be possible to downsize the nozzle to an "optimum" size i.e. equal to or greater than the rate required to heat the house at design temperature . The optimum nozzle size reference table provides the adviser with optimum nozzle size values for various levels of fuel consumption per degree-day (as calculated in the detailed fuel oil consumption estimate). The values shown in the table are based on the following sizing equation:

$$\text{ONS} = \frac{T}{K \times 24 \times .26 \times 3} \qquad (9)$$

where

ONS = optimum nozzle size in U.S. gal per hour
K = fuel consumed in litres per degree days for a given period
T = avg. indoor temperature - design temp. in °C (e.g. 18°C and -25°C for Ottawa)
24 = time conversion in hours per day
.26 = fuel unit conversion in U.S. gallons per litre
3 = safety factor established in field tests by CCRL

If no fuel records are available to determine fuel consumption per degree-day., the adviser uses the optional sizing table which specifies optimal nozzle sizes as a function of heat load in W/°C and steady-state efficiency based on the following formula:

$$\text{ONS} = \frac{SF \times H_m \times T \times 3600 \text{ sec/hr}}{J \times SSE} \qquad (10)$$

where

ONS = optimum nozzle size in U.S. gal. per hour
SF = safety factor of 1.15
H_T = total heat load from envelope worksheet in W/°C
T = average indoor temperature - design temp. in °C
J = no. of joules per U.S. gal of oil (145×10^6 joules)
SSE = steady-state efficiency

The optimum nozzle size estimate in accompaniment with retrofit is constrained by the minimum available nozzle size (.5 USGPH) and by the stack temperature as shown on the maximum downsizing worksheet on the heating system inspection form. The number of size reductions allowable for a given temperature was based on the following formula:

$$AFR = \frac{T_S - 350}{50} \qquad (11)$$

where

AFR = allowable firing rate
T_S = flue gas temperature at breech in °F
350 = minimum safe stack temperature in °F
50 = assumed flue gas temperature drop per nozzle size in °F

The savings calculation for retrofit downsizing assumes that each 10% overfiring capacity reduces seasonal performance by 1 - 1.5% (assume 1.3%). This is based on data presented in the seasonal efficiency chart cited by Quirouette, Scheuneman in Estimating Energy Savings from Re-insulating Houses (NRC 1981)

Consequent savings are determined by the percent oversizing times a savings factor of .0013 times the projected oil heating cost. More specifically.

$$NDS = \frac{NS1 - NS2}{NS2} \times 100 \times NSF \times OHC \quad (12)$$

where

NDS = nozzle downsizing savings
NS1 = existing nozzle size
NS2 = recommended nozzle size
NSF = savings factor of .0013
OHC = projected oil heating cost

If no retrofit work is recommended for the heating system, it is assumed that the nozzle cannot be downsized to more than one size lower than the CSA minimum specified on the furnace rating plate. The adviser consults the optimum nozzle size table to determine an optimum size but if necessary must increase the recommended size so that it is not lower than the CSA minimum (minus one size) or the maximum downsize permitted at the current stack temperature.

Without retrofit, CCRL data indicates that downsizing savings can be expected to be no greater than 3%.

6. GENERAL OBSERVATIONS

The following observations are based on approximately 4 months of audit design work. They are intended to provide a context for further development of the audit procedure.

(1) Design Approach

Our design approach was essentially to start with a sophisticated Princeton-level audit procedure and then to reduce the level of analytical detail until a manageable procedure for mass delivery was established. This was often an unsatisfying process since the quality of analysis in terms of thoroughness and depth had to be continually sacrificed to obtain a manageable length for the procedure. However, the approach was valuable since it placed the ECAP audit on a solid technical foundation and established a clear sense of the capacity of a 2½ hour audit. It may also serve to caution those who may wish to add technical complexity to the current procedure.

(2) Development Priorities

Limited field tests indicate that the ECAP audit can only operate at a general level of technical detail - a sort of highly educated walk-through. The number of measures under consideration means that time simply does not permit more than a cursory analysis of the many relevant features of the building. This may be a disappointing result for those concerned with the quality of inspections but it corresponds well with U.S. experience.

Furthermore, our experience has been that the quick assessments which are required tend to depend as much on the adviser's experience and judgement as on definitive measurement. Consequently, it is our view that "free" program audits (as opposed to consultant or research audits) are more correctly viewed less as exercises in rigourous technical analysis than as opportunities to educate, advise, and motivate the householder on the basis of a well-trained adviser's knowledge and appropriate supporting information materials.

For this reason, we suggest that the current emphasis on technical issues must now shift to refining the "adult education" and "consumer assistance" aspects of the audit program. Priority should be placed on developing the supporting delivery, training and information systems which will facilitate effective interaction with the householder.

(3) Technical Refinements

The key technical task at present is to use the field test program to adapt the procedure to PEI conditions, to adjust inspection forms and reference tables for maximum ease of on-site use and to broaden the flexibility of the procedure to make it fully adaptable to the range of homes in the housing stock.

Instrumentation and calculation methodology improvements, while important in streamlining the technical analysis (i.e. packing more analysis and recommendation details into a shorter time) are not priorities. They should be phased in gradually as program requirements become more defined.

With regard to the scope of technical content, it is worth emphasizing that there is a finite limit to the number of technical details which (1) the adviser can handle on a day-to-day basis without unacceptable error rates or job overload and which (2) the householder can reasonably be expected to comprehend and assimilate. A variety of measures have already been excluded on this basis. In addition, other measures such as super-insulation and air-to-air heat exchangers simply require more time than is provided in the audit to perform the level of analysis which is necessary to provide responsible advice.

Finally, while there is a legitimate inclination to make the audit fully reflect the state-of-the-art of building science research it should also be recognized that the audit must be structured to realistically account for the considerable lag in knowledge levels within the weatherization trades on whom householders must depend to implement measures. (Quality of work improvements within the weatherization trades is a separate but important issue).

(4) Information

An audit is an on-site information program. Consequently, the analytical methodology must serve the objectives of the information program and can usefully be no more refined than the information package which explains the audit results and provides follow-up information to the householder. There is a critical need to develop such packages since existing information is inadequate. In addition, to improve the follow-up services on which the audit depends, there is a need to adequately inform the weatherization trades of the audit's technical content and objectives. Effective marketing strategies for the audit service are also required.

A comprehensive information program is critical to the success of the audit program. In our view, a large amount of work remains to be done to bring the information side of the program to an acceptable level. Budget allocations should be adjusted to reflect this requirement.

(5) Adviser Skills

While the level of technical analysis is constrained by available on-site time and the quality of supporting information materials, it is essentially determined within these constraints by the technical and communications skills of the adviser. It is clearly in the program's interest to hire high quality advisers. However, since communications skills will tend to be a first priority for such a high profile government program, it remains to be seen exactly what level of technical skills can be established in the adviser team and to what extent turn-over rates as a result of the day-to-day grind of audit delivery may affect the teams technical skills over time. In any event the audit methodology will have to be adjusted to the level of skill of the advisers who will be delivering it. In this regard it is worth noting that the ECAP methodology is likely to be somewhat biased towards the detailed building science skills of the professionals who are involved in developing it. This lends further weight to the view that further development should proceed in the direction of simplifying rather than complicating the on-site procedure.

(6) Training

An adequate training program will take time to develop since an effective program requires a finalized and proven procedure, instructors with experience in auditing, and training materials specific to the procedure and local conditions. None of these requirements can be adequately met at present. For this reason, training efforts during the first year of pilot operations will very much be pilot exercises in themselves. A major effort will be required during this period to develop a model curriculum. Once on-the-job experience in management and delivery has been achieved, training will become much more straighforward.

(7) Delivery

During the five-week review and revision period since the submission of the first version of the audit, we have become much more convinced that a one-adviser one-visit approach is the only feasible way to deliver the audit. Two step approaches are almost certainly more costly to administer, organize and deliver than is warranted by any improvements in results. Two adviser systems similarly are not likely to justify the additional costs - the ECAP audit is at a level of detail not suited to an effective division of tasks and the presence of two advisers is more likely to detract from than add to the impression of professionalism and efficiency that should be established with the householder. U.S. experience confirms these conclusions.

(8) United States Work

Audit development work in the United States is approximiately 2 years more advanced than in Canada. A variety of U.S. programs and agencies (e.g. RCS, TVA, Energyworks, Equifax, Cornerstones) provide valuable models and sources of expertise which should be fully utilized to facilitate Canadian development work. However, perhaps the most fundamental insight from the U.S. experience relates to establishing realistic developmental lead-time for the fledgling Canadian energy audit program. Years rather than months will be required to establish a fully adequate level of service. A substantial amount of technical, information, training, research and evaluation work is still ahead of us.

(9) Computerization

Excellent computer programs have been developed in the United States for both audit analysis and information presentation (e.g. Cornerstones, Massave). These can serve as invaluable models for designing Canadian programs. However, it is important that all components of the pilot audit service should first be developed, before placing heavy emphasis on computerization. This will ensure that computer programs are designed at a level of complexity and scope which adequately meets actual program requirements.

(10) Evaluation

A common proposal in terms of evaluative research is to compare the accuracy of different procedures. However, the results of such comparisons are likely to be predictable in advance since accuracy is a direct function of (1) the documented methodology (2) the amount of on-site analysis time and (3) the large and often imponderable indeterminacy in most of the variables which effect cost and saving calculations (e.g. air changes, free heat, availability of fuel records, weather conditions, envelope shape, lifestyle variables, savings assumptions, cost component assumptions, consumer decisions, quality of work, economic variables etc.)

In fact, given the range of unpredictable,immeasurable or poorly understood variables, the absolute accuracy of ECAP-type audits will likely be difficult to determine. The pronounced lack of solid quantitative information on the predictive capabilities of audits tends to suppport this view.

Fortunately, audit accuracy is much less a question of absolute values than of the extent to which a thorough and appropriate plan of action is generated. The audit need only be designed to be sufficiently accurate in discriminating between the relative benefits of various measures so that it can provide useful results.

to the householder. Unlike researchers who require detailed technical data, householders require more general results which will provide clear direction, inspire confidence and be easy to understand and act on in the current somewhat confusing and intimidating energy conservation marketplace.

The degree of detail and discrimination in audit results is essentially a function of cost (i.e. the amount of investment in the length and sophistication of analysis). Consequently, the key questions in comparative analysis become (1) to what extent are the delivered results improved as the cost of the audit increase and to what extent does the householder actually benefit from the improvements generated by a more expensive audit. Clearly, added expense is only justified if there is a significant improvement in (1) priorization of measures or (2) the amount of information which can actually be used by the householder.

Furthermore, evaluation work should consider accuracy mainly in the context of measuring the effectiveness of the audit in meeting the principle objective of helping householders to spend grant funds more effectively. This is a function of many things in addition to technical methodology including adviser skills, householder's knowledge levels, type of house, effectiveness of information materials, and marketplace barriers.

(11) Objectives

Since evaluation is essentially an exercise in measuring how well objectives have been met, there is a requirement to clarify audit program objectives to facilitate work on program development and evaluation design. For example, it is not yet clear whether the audit will be mandatory for ECAP applicants and to what extent audit recommendations will be linked to grant eligibility. Decisions on these and other policy issues will effect the role and hence the structure of the audit program.

APPENDICES

APPENDIX 1

ECAP HOME ENERGY SURVEY INSPECTION FORMS

Manual Version

NOTE : ALL COSTS IN DOLLARS
: ALL DIMENSIONS IN METRES
: REGIONAL COST FACTORS MUST BE ENTERED BEFORE USE
: FREE HEAT, AIR CHANGE AND DHW COST FACTORS BASED ON P.E.I. CONDITIONS

GENERAL INFORMATION

CLIENT IDENTIFICATION

NAME		DATE	
ADDRESS		TIME	
PHONE		ADVISER	

RESIDENCE IDENTIFICATION

TYPE OF HOME		SINGLE		SEMI DETACHED		DUPLEX		TRIPLEX		ROW		
YEAR OF CONSTRUCTION		BEFORE 1920		1920-45		1946-60		1961-70		AFTER 1970		
NUMBER OF STOREYS		ONE		ONE AND A HALF		TWO		TWO AND A HALF		THREE		SPLIT LEVEL ENTRY
WALL CONSTRUCTION		WOOD FRAME		SOLID MASONRY		SOLID LOG						
TYPE OF FOUNDATION		BASEMENT		CRAWL SPACE		SLAB ON GRADE						

CLIENT INTERVIEW

NUMBER OF RESIDENTS														
THERMOSTAT SETTINGS	DAY		EVENING		NIGHT									
DAILY DHW USE (LITRES)	20	45	GENERAL	15	WASHER (HOT CYCLE)	10	DISH WASHER	6X		BATHS PER WEEK	6X		SHOWERS PER WEEK	TOTAL
BASEMENT TEMPERATURE	20	WARM	17	COOL	15	COLD								
RESIDENT LEVEL	1	1-2	2	3-4	3	5 OR MORE								
BASEMENT HUMIDITY	1	DRY	2	COOL AND DAMP	3	WARM AND DAMP								
DRYER VENTING OR CLOTHESLINE	1	OUTDOORS	2	INDOORS SOMETIMES	3	INDOORS REGULARLY								
WINTER HUMIDIFIER USE	1	NONE	2	SOME	3	REGULAR								
MOISTURE RATING														
REINSULATION HISTORY		REINSULATED PAST SEASON		REINSULATED PREVIOUSLY	SEALED									
CURRENT PROBLEMS		MOISTURE		DRAFTS		COLD ROOMS		HEATING SYSTEM						
COMMENTS														

AIR CHANGE ESTIMATE

HUMIDITY LEVEL	MOISTURE RATING		
	3-5	6-8	9-12
DRY OR STATIC ELECTRICITY	.7	.8	.9
NORMAL OR LIGHT FOGGING	.5	.6	.7
HUMID OR HEAVY FOGGING	.3	.4	.5
EXPOSURE FACTOR	1.5		

PROJECTED SPACE HEATING COST ESTIMATE

FUEL TYPE(S)	COST ESTIMATE PAST SEASON	DEGREE-DAY FACTOR	FUEL ESCALATION FACTOR	PROJECTED HEATING COST	DHW CORRECTION (IF APPLICABLE)	PROJECTED SPACE HEATING COST	TOTAL PROJECTED SPACE HEATING COST
OIL							
ELECTRICITY							
WOOD							

DETAILED FUEL OIL CONSUMPTION ESTIMATE (IF RECORDS AVAILABLE)

DELIVERY DATE		AMOUNT DELIVERED IN LITRES	CUMULATIVE DEGREE-DAYS	PROJECTED OIL HEATING COST	
DATE	YEAR				
		REFERENCE		FUEL CONSUMED PER DEGREE-DAY	
				AVERAGE DEGREE-DAYS	
				PROJECTED FUEL OIL PRICE	
				PROJECTED OIL HEATING COST	
TOTALS					

BUILDING DIMENSIONS

(ENTER BASIC BUILDING DIMENSIONS, SIZE AND TYPE OF WINDOWS AND DOORS, AND AMOUNT OF FOUNDATION ABOVE GRADE)

FRONT VIEW **ORIENTATION**

REAR VIEW

RIGHT SIDE VIEW

LEFT SIDE VIEW

FIRST FLOOR PLAN VIEW

AREA		PERIM LENGTH	HEIGHT WIDTH	GROSS AREA	OPEN AREA	TOTAL AREA	RSI
5 FDN							
6 ATTIC							
7 SIDE ATTIC							
8 ROOF							
9 MAIN WALL							
10 ADDED WALL							
11 EXP FLOOR							

WINDOWS AND DOORS	TYPES			TOTAL NUMBER	SEAL		SUB-AREAS			TOTAL AREA	RSI
	S	M	L		%	No.	5	1	1.5		
1 SINGLE PANE											15
2 DOUBLE PANE											.28 4 .5
3 DOORS	REGULAR						2				5
4 DOORS	STORM OR THERMAL						2				7

ENVELOPE INSPECTION

AREA	STRUCTURE	INSULATION	RSI	SEAL	WALL ACC.	MAINTENANCE FLAGS		DETAILS				
FOUNDATION						REPAIR MOISTURE PROBLEMS						
						REPAIR STRUCTURAL PROBLEMS						
						MOVE WATER PIPES						
						INSULATE WINDOWS						
ATTIC						ADD VENTS (IF DAMP)						
						REPLACE DAMP INSULATION						
						IMPROVE INSULATION		LEVEL UNEVEN AREAS		IMPROVE FIT		
						REPLACE MISSING INSULATION		AT ATTIC HATCH		AT KNEE WALL		BETWEEN JOISTS
						PROTECT RECESSED LIGHTS/FANS						
						IMPROVE DUCT WORK		TAPE JOINTS		ADD INSULATION		RE-ROUTE
						IMPROVE WIRING		EXPOSED		FRAYED		CORRODED
						ADD RAFTER SUPPORT						
SIDE ATTIC						ADD VENTS (IF DAMP)						
						REPAIR MOISTURE PROBLEMS						
						IMPROVE INSULATION						
ROOF						REPAIR MOISTURE PROBLEMS						
						IMPROVE INSULATION						
MAIN WALL						REPAIR MOISTURE PROBLEMS						
						REPAIR STRUCTURAL PROBLEMS						
ADDED WALL						REPAIR MOISTURE PROBLEMS						
						REPAIR STRUCTURAL PROBLEMS						
EXP. FLOOR						REPAIR MOISTURE PROBLEMS						
						IMPROVE INSULATION						

VENT WORKSHEET	VENT TYPE	AREA	TOTAL VENT AREA	OPTIMUM AREA PER M^2 OF ATTIC		ATTIC AREA	OPTIMUM VENT AREA	ADDITIONAL VENT AREA
				SOFFIT SYSTEMS	NON-SOFFIT SYSTEMS			
				.0033	.0066			

EXTERIOR INSPECTION

ROOF		POOR SHINGLES		POOR FLASHING		MELTING		STRUCTURAL PROBLEM	
SOFFITS		PEELING		ROTTING		POOR TROUGH			
VENTS		BLOCKED		NO LOUVRES		POOR LOCATION			
CHIMNEY		SPALLING		LOOSE MASONRY		DAMAGED CAP			
SIDING		PEELING		LEAKS		UNFINISHED		STRUCTURAL PROBLEM	
WINDOWS		LOOSE STORMS		BROKEN PANES		POOR CAULK			
FOUNDATION		CRACKS		LEAKS		LOOSE MASONRY		STRUCTURAL PROBLEM	
DRAINAGE		EROSION		POOR SLOPE	E	W	N	S	
FILL PIPE		POOR SEAL		LEAKS		NO CAP		LOOSE	

THERMOSTAT SETBACK DEVICE

MEASURED INDOOR TEMPERATURE			°F THERMOSTAT CUT-IN (MINUS 1°F)							°F ERROR				
AUTOMATIC SETBACK DEVICE IN USE			YES		NO									
DAYTIME SETBACK	CURRENT SETTING	75	74	73	72	71	70	69						
	PERCENT SAVINGS	10.5	9	7.5	6	4.5	3	1.5						
NIGHTIME SETBACK	CURRENT SETTING	75	74	73	72	71	70	69	68	67	66	65	64	63 OR LESS
	PERCENT SAVINGS	12	11	10	9	8	7	6	5	4	3	2	1	0
SAVINGS WORKSHEET	TOTAL PERCENT SAVINGS	ADJUSTED OIL COST				TOTAL SAVINGS				COSTS		PAYBACK		
										110				
TEMPERATURE CONVERSIONS	FAHRENHEIT		74	73	72	71	70	69	68	67	66	65	64	63
	CENTIGRADE	23.5	23	22.5	22	21.5	21	20.5	20	19.5	19	18.5	18	17

DOMESTIC HOT WATER

MEASURED HOT WATER TEMPERATURE		°F								
SUITABILITY FOR FLOW RESTRICTOR		SHOWER		KITCHEN FAUCET		BATHROOM FAUCET				
TYPE OF SYSTEM		OIL		ELECTRICITY		TANKLESS COIL		STORAGE TANK		PRE-HEAT TANK
TANK CAPACITY		GAL.								
MORE THAN 3 YEARS FURTHER LIFE		YES		NO						
TANK INSULATION (MM)		0		25		50		75 OR MORE		
MORE THAN 50MM CLEARANCE		YES		NO						

DHW COST WORKSHEET	DAILY USE PER PERSON	NUMBER OF RESIDENTS	REPLACEMENT COST FACTOR		HEATING TEMP. FACTOR	REPLACEMENT COST	STANDBY COST	ESTIMATED DHW COSTS	HEATING COST CORRECTION
	P	N	F		T	R = P·N·F·T	SB = SF·T	C = R+SB	.6C
			1.4 OIL	3.3 ELECTRIC					

COST FACTORS AND SAVINGS WORKSHEET

STANDBY LOSS COST FACTOR SF					TEMPERATURE FACTORS			INSULATION SAVINGS				
TANK INSULATION	OIL SYSTEMS	ELECTRIC SYSTEMS			WATER TEMP.	HEATING FACTOR	SETBACK FACTOR	TANK INSULATION	OIL SYSTEMS	ELECTRIC SYSTEMS		
MM	25 GAL.	25 GAL.	40 GAL.	60 GAL.	°F	T	TS	MM	25 GAL.	25 GAL.	40 GAL.	60 GAL.
0	230	550	770	1400	160	1	.4	0	220	500	730	[illegible]
25	60	140	200	350	150	.9	.3	25 50	30	60	90	160
50	35	75	100	200	140	.8	.2	FLOW RESTRICTOR SAVINGS			SETBACK SAVINGS	
75	25	60	75	140	130	.7	.1	S/P x C/2 OR .15 C			TS x C	
100	20	45	60	100	120	.6	0					

SUMMARY WORKSHEET

ACTION	COSTS	SAVINGS	PAYBACK
REDUCE TEMPERATURE TO 120°F	—		
ADD RSI 2.1 OR RSI 3.5	20-30		
INSTALL FLOW RESTRICTORS	30		
INSTALL NEW HIGH EFFICIENCY SYSTEM	800		

OIL HEATING SYSTEMS

MAINTENANCE FLAGS	GENERAL REPAIR		FILLING PIPE		OIL LINES		FLUE PIPE		BARO DAMPER		FURNACE CASING		DOOR SEALS
	FAN AND FILTER		FAN BEARINGS NEED REPLACEMENT		FAN BLADES NEED CLEANING		FAN BELT NEEDS ADJUSTMENT		FILTERS NEED REPLACEMENT				
	COMBUSTION AIR SUPPLY		OK		INCREASE SUPPLY								
	HEATING DUCTS OR PIPES		TAPE DUCTS		INSULATE DUCTS		INSULATE PIPES						
	DUCT IMPROVEMENT		STRAIGHTEN DUCTS		SEAL REGISTERS		IMPROVE FIT OF REGISTERS						
BOILER/ FURNACE REPORT	TYPE		GRAVITY		FORCED		HOT WATER		WARM AIR		STEAM		
	MANUFACTURER AND MODEL NO.												
	AGE IN YEARS		0-5		6-10		11-15		16-20		MORE THAN		
	RATED BTU SPECIFICATIONS	INPUT:					OUTPUT:						
	MINIMUM NOZZLE SPEC.	USGPH											
BURNER REPORT	TYPE		CONVENTIONAL		FLAME RETENTION		BLUE FLAME		OTHER				
	MANUFACTURER AND MODEL NO.						SUITABLE FOR RETENTION HEAD		YES		NO		
	AGE IN YEARS		0-5		6-10		11-15		MORE THAN 16				
	NOZZLE SIZE		USGPH		NOT KNOWN								
	SOLENOID VALVE		YES		NO								
FORCED AIR SYSTEMS	CONTINUOUS FAN OPERATION		YES		NO								
	FAN TEMPERATURE SETTINGS	CUT-OUT	CUT-IN	°F									
HYDRONIC SYSTEMS	CIRCULATING PUMP		YES		NO								
	CONTINUOUS OPERATION		YES		VARIABLE AQUASTAT		YES		NO				
EFFICIENCY AND TUNING TESTS	STEADY-STATE EFFICIENCY		CO_2 READING AND STACK TEMP.										
	TUNING TESTS	DRAFT		SMOKE									

CALCULATION TABLES

NOZZLE SIZES												CURRENT SIZE	NS1	
2.25	2	1.75	1.5	1.25	1.1	1.0	.85	.75	.65	.6	.5	NON – RETROFIT MINIMUM SIZE	NS2	
MAXIMUM DOWNSIZING STOPS AT MEASURED STACK TEMP.												MAXIMUM DOWN SIZE	NS3	
400°F	450°F	500°F	550°F	600°F	650°F	700°F	750°F	800°F				RECOMMENDED SIZE	NS4 (≥ NS3)	
1	2	3	4	5	6	7	8	9				% OVERSIZING	$\frac{NS1-NS4}{NS4}$	

RETROFIT DOWNSIZING SAVINGS			
PERCENT OVERSIZING	SAVINGS FACTOR	PROJECTED OIL HEATING LOST	DOWNSIZE SAVINGS
	.0013		

RETROFIT SAVINGS										
CURRENT EFFICIENCY	75	74	73	72	71	70	69	68	67	66
PERCENT SAVINGS	6	8	9	10	11	12	14	15	15	15
PROJECTED OIL HEATING COST					SAVINGS					

SUMMARY WORKSHEET

ACTION	COSTS	PERCENT SAVINGS	PROJECTED OIL COST	SAVINGS	PAYBACK
HAVE SYSTEM TUNED	15	.05			
INSTALL SOLENOID VALVE	40	.03			
HAVE SYSTEM SERVICED	25	.05			
REDUCE FAN SETTINGS TO 120°F AND 90°F	NIL	.04			
INSTALL CIRCULATING PUMP	400	.25			
INSTALL RETENTION HEAD KIT	200				
REPLACE BURNER	400				
INSTALL NEW HIGH EFFICIENCY UNIT	1,600				
DOWNSIZE NOZZLE TO NO LOWER THAN_____ USGPH	4	.03			

BUILDING ENVELOPE WORKSHEET

	CURRENT THERMAL PERFORMANCE				POTENTIAL SAVINGS			ESTIMATED COSTS				PAYBACK	
COMPONENT	AREA	RSI	HEAT FLOW	PERCENT FLOW	NEW RSI	PS	SAVINGS	DO-IT-YOURSELF		CONTRACTOR			
	A	R_1	$C=A/R_1$	$P=C/H_T$	R_2	$P(1-R_1/R_2)$	$S=PS \cdot HC_A$	FACTOR	COSTS	FACTOR	COSTS	D	C
	M²	°CM²/W	W/°C	%	°CM²/W	%	$	$/M²	$	$/M²	$	YEARS	YEARS
1 SINGLE WINDOWS					.35								
2 DOUBLE WINDOWS					—								
3 REGULAR DOORS					2.1								
4 STORM DOORS					—								
5 BASEMENT					2.1								
CRAWL SPACE					2.1								
FLOOR OR SLAB					2.1								
6 MAIN ATTIC					5.6								
7 SIDE ATTIC FLOOR					5.6								
SIDE ATTIC WALL					2.1								
SIDE ATTIC SLOPE					2.1								
8 ROOF					3.5								
9 MAIN WALL					2.1								
10 ADDED WALL					2.1								
11 EXP. FLOOR					4.6								

TOTAL AREA A_T			C_T			SEAL DOORS	5	3							
AIR CHANGE PER HOUR		AIR CHANGE LOSSES	AC_T			SEAL WINDOWS	15	10							
TOTAL HEATING LOAD			H_T		100	SEAL FDN	10								
PROJECTED HEATING COST			HC			SEAL WALLS	10								
FREE HEAT FACTOR F		ADJUSTED COST F x HC	HC_A			SEAL ROOF	10								

FREE HEAT RATING					PEI FREE HEAT CORRECTION FACTOR F									
					HEAT LOSS RANGE IN W/°C									
SOLAR EXPOSURE	SHADED	AVERAGE	GOOD	RATING LEVEL	150-200	201-250	251-300	301-350	350 -400	401-450	451-500	501-550	551-600	601-650
NUMBER OF RESIDENTS	1-2	3-4	5 OR MORE	2	1.40	1.30	1.25	1.20	1.15	1.15	1.10	1.10	1.10	1.10
				3-5	1.60	1.50	1.40	1.30	1.25	1.20	1.20	1.20	1.15	1.15
LEVEL	1	2	3	6	2.30	2.00	1.70	1.55	1.45	1.40	1.35	1.30	1.25	1.20

HERE ARE THE RESULTS OF YOUR HOME ENERGY SURVEY

WHAT WAS ANALYSED		WHAT WE RECOMMEND	COST OF THE JOB		YOUR ANNUAL SAVINGS	PAYBACK IN YEARS	PRIORITY	REQUIREMENTS
			DO-IT YOURSELF	CONTRACTOR INSTALLED				
SEALING	WINDOW WEATHERSTRIP							
	DOOR WEATHERSTRIP							
	ENVELOPE CAULKING							
INSULATION	ATTIC							
	SIDE ATTIC							
	ROOF							
	WALL							
	FLOOR							
	FOUNDATION							
	ADDITIONAL WALL							
	STORM WINDOWS AND DOORS							
HEATING SYSTEM	THERMOSTAT SETBACK							
	CIRCULATION SYSTEM							
	TUNING AND SERVICE							
	RETROFIT POTENTIAL							
	NOZZLE SIZE							
HOT WATER SYSTEM	TANK INSULATION							
	TEMPERATURE SETTINGS							
	FLOW RESTRICTORS							

REFERENCE INFO

CLIENT		
PROJECTED COSTS [illegible]	TOTAL HEATING COSTS	HOT WATER COSTS
HEATING SYSTEM	CURRENT EFFICIENCY	NOZZLE SIZE
MINIMUM NOZZLE SIZE	WITH TUNING	WITH RETROFIT
ADVISER		DATE

APPENDIX 2

REFERENCE TABLES FOR ECAP ADVISERS

- AIR CHANGE HEAT LOSS FACTOR TABLE
- OPTIMUM NOZZLE SIZE TABLE
- CUMULATIVE DEGREE-DAY CHART
- RSI VALUES FOR COMMON ASSEMBLIES
- EQUIVALENT RSI VALUES FOR MASONRY BASEMENT WALLS
- RSI VALUES FOR COMMON BUILDING MATERIALS
- LIST OF FURNACES AND BURNERS SUITABLE FOR RETENTION HEAD

Cumulative Degree-Day Chart

REGION		TOTAL DEGREE-DAYS	
YEAR		AVERAGE DEGREE-DAYS	
BASE TEMPERATURE		NORMALIZATION FACTOR	
HEATING SEASON	SEPT. 15 - APR. 15	DESIGN TEMPERATURE	

SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL	
DATE		DATE		DATE		DATE		DATE		DATE		DATE		DATE	
15		1		1		1		1		1		1		1	
16		2		2		2		2		2		2		2	
17		3		3		3		3		3		3		3	
18		4		4		4		4		4		4		4	
19		5		5		5		5		5		5		5	
20		6		6		6		6		6		6		6	
21		7		7		7		7		7		7		7	
22		8		8		8		8		8		8		8	
23		9		9		9		9		9		9		9	
24		10		10		10		10		10		10		10	
25		11		11		11		11		11		11		11	
26		12		12		12		12		12		12		12	
27		13		13		13		13		13		13		13	
28		14		14		14		14		14		14		14	
29		15		15		15		15		15		15		15	
30		16		16		16		16		16		16			
		17		17		17		17		17		17			
		18		18		18		18		18		18			
		19		19		19		19		19		19			
		20		20		20		20		20		20			
		21		21		21		21		21		21			
		22		22		22		22		22		22			
		23		23		23		23		23		23			
		24		24		24		24		24		24			
		25		25		25		25		25		25			
		26		26		26		26		26		26			
		27		27		27		27		27		27			
		28		28		28		28		28		28			
		29		29		29		29				29			
		30		30		30		30				30			
		31				31		31				31			
CUMULATIVE		61		91		122		153		181		212		227	

Air Change Heat Loss Factor in W/°C

VOLUME IN M³	ENVELOPE AREA IN M²		AIR CHANGE RATE IN CHANGES PER HOUR											
	1 OR 2 STOREY OR HALF STOREY	SPLIT LEVELS L-SHAPES ADDITIONS	.3	.4	.5	.6	.7	.8	.9	1.0	1.1	1.2	1.3	1.4
150	170	196	15	20	25	30	35	40	45	50	55	60	65	70
200	205	235	20	30	35	45	50	60	65	70	80	85	90	95
250	240	275	25	35	45	55	65	75	80	90	100	110	120	130
300	275	310	35	45	55	65	75	85	95	110	120	130	140	150
350	300	340	40	50	60	75	90	100	115	125	140	150	165	180
400	330	370	45	60	70	85	100	115	130	145	160	175	190	205
450	355	400	50	65	80	95	120	125	145	160	180	190	210	230
500	380	430	55	70	90	110	125	145	160	180	200	215	235	255
550	405	460	60	80	100	120	140	160	180	200	220	240	260	280
600	430	485	65	85	110	130	150	175	195	215	240	260	280	300
650	455	510	70	95	120	140	165	190	210	235	260	280	305	330
700	475	535	75	100	130	150	175	200	275	250	280	305	330	355
750	500	560	80	110	140	160	190	215	243	270	300	330	350	370
800	520	585	85	105	145	175	205	235	260	290	320	350	375	400
850	540	605	90	125	155	185	215	245	275	305	340	370	400	430
900	560	630	95	130	160	195	225	260	290	325	355	390	420	450
950	580	655	100	140	170	205	240	275	310	340	375	410	445	480
1000	600	680	110	145	180	215	250	290	325	360	400	435	470	505

Optimum Nozzle Size in USGPH

EFFICIENCY GAIN (%)	FUEL CONSUMED IN LITRES PER DEGREE-DAYS (IF RECORDS AVAILABLE)																											
	.4	.5	.55	.6	.65	.7	.75	.8	.85	.9	.95	1.0	1.05	1.1	1.15	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
0	.5	.5	.6	.6	.65	.75	.75	.85	.85	1.0	1.0	1.0	1.1	1.1	1.25	1.5	1.5	1.5	1.5	1.75	1.75	2	2	2	2.25	2.25	2.25	2.25
5	.5	.5	.5	.6	.6	.65	.75	.75	.85	.85	.85	1.0	1.0	1.0	1.1	1.1	1.1	1.25	1.5	1.5	1.5	1.75	1.75	2	2	2	2	2.25
10	.5	.5	.5	.5	.6	.6	.65	.75	.75	.85	5.85	.85	1.0	1.0	1.0	1.1	1.1	1.25	1.25	1.5	1.5	1.5	1.75	1.75	1.75	2	2	2.25
15	.5	.5	.5	.5	.6	.6	.6	.65	.75	.75	.85	.85	.85	1.0	1.0	1.0	1.1	1.25	1.25	1.25	1.5	1.5	1.5	1.75	1.75	1.75	2	2

STEADY STATE EFFICIENCY (%)	TOTAL HEAT LOAD IN WATTS/°C (IF NO RECORDS AVAILABLE)													
	200-250	251-300	301-325	326-350	351-375	376-400	401-425	426-450	451-475	476-500	501-550	551-600	601-650	651-700
85	.5	.5	.5	.5	.5	.6	.6	.6	.65	.65	.65	.75	.85	1.0
80	.5	.5	.5	.5	.5	.6	.6	.6	.65	.75	.75	.85	.85	1.0
75	.5	.5	.5	.6	.6	.6	.6	.65	.75	.75	.85	1.0	1.0	1.1
70	.5	.5	.6	.6	.6	.65	.75	.75	.85	.35	1.0	1.0	1.1	1.1
65	.5	.5	.6	.6	.65	.75	.75	.75	85	.85	1.0	1.1	1.1	1.25
60	.5	.6	.6	.65	.75	.75	.85	.85	1.0	1.0	1.1	1.25	1.25	1.5
55	.6	.6	.75	.75	.85	.35	1.0	1.0	1.0	1.1	1.25	1.25	1.5	1.5

RSI Values for Common Assemblies

(ADD BASE RSI TO ADJUSTED RSI FOR INSULATION IF APPLICABLE)

	TYPE OF SHEATHING		BASE RSI			TYPE OF INSULATION	ADDED RSI AT VARIED WIDTHS (MM)			
			TYPE OF SIDING							
	EXTERIOR	INTERIOR	STUCCO	WOOD OR ALUMINUM	BRICK		50	76	89	95
WALLS	PLYWOOD	DRYWALL	.5	.6	.7	ROCKWOOL BATTS	1.1	1.5	1.6	–
	LUMBER	GYPSUM LATH AND PLASTER	.5	.7	.8	FIBREGLASS BATTS	1.0	1.4	1.5	–
	LUMBER	INSULATED LATH AND PLASTER	.7	.9	1.0	ROCKWOOL LOOSE	–	–	1.5	1.6
	LUMBER	LUMBER SHEATING AND PLASTER	–	.9	–	FIBREGLASS LOOSE	–	–	1.4	1.5
	INSULATED	LATH AND PLASTER OR DRYWALL	.6	.7	.8	CELLULOSE FIBRE	–	–	1.8	1.9
	INSULATED	INSULATED LATH AND PLASTER	.8	–	1.0	POLYSTYRENE LOOSE	–	–	1.4	1.5
						VERMICULITE	–	–	1.0	1.1
						WOOD SHAVINGS	–	–	1.2	1.3

	TYPE OF ASSEMBLY	BASE RSI		TYPE OF INSULATION	ADDED RSI AT VARIED DEPTHS (MM)					
		VENTED	UNVENTED		50	100	150	200	250	300
ATTICS	JOIST LATH AND PLASTER OR DRYWALL	.2		ROCKWOOL BATTS	1.0	2.0				
				FIBREGLASS BATTS	–	1.9	2.9	4.0	5.1	6.2
				ROCKWOOL LOOSE	–	–	2.9	4.0	5.1	6.2
	JOIST FIBREBOARD PLASTER	.5		FIBREGLASS LOOSE	–	–	2.7	3.8	4.8	5.8
				CELLULOSE LOOSE	–	–	3.4	4.8	6.1	7.4
				VERMICULITE	.2	1.4	2.1	2.9	3.6	4.3
				WOOD SHAVINGS	.8	1.6	–	–	–	–

	TYPE OF ASSEMBLY			BASE RSI	TYPE OF INSULATION	ADDED RSI AT VARIED DEPTHS (MM)					
						50	100	140	184	235	286
ROOF AND FLOOR	ROOF	19 MM DECK	LATH AND PLASTER OR DRYWALL	.6	ROCKWOOL BATTS	1.0	2.0	2.6	3.6	4.6	5.6
			16 MM PLYWOOD AND DRYWALL	.6	FIBREGLASS BATTS	–	1.9	2.5	3.5	4.4	5.3
			INSULATED LATH AND PLASTER	.8	ROCKWOOL LOOSE			2.4	3.2	4.2	5.1
		38 MM DECK	LATH AND PLASTER OR DRYWALL	.8	FIBREGLASS LOOSE			2.3	3.0	3.9	4.8
	FRAME FLOOR	CARPET OR TILE	19 MM SUBFLOOR JOIST	.5	CELLULOSE FIBRE				3.8	4.9	5.9
			19 MM SUBFLOOR JOIST AND DRYWALL	.6	VERMICULITE	.7	1.4	1.6	2.3	3.0	3.7

BASED ON CMHC DATA 1977

Equivalent RSI Values for Masonry Basement Walls

	HEIGHT ABOVE GRADE (MM)	RSI VALUE FOR COOL BASEMENT (15°C)	RSI VALUE FOR PARTIALLY HEATED BASEMENT (17°)	RSI VALUE FOR HEATED BASEMENT (20°C)
WALLS WITH NO INSULATION	0	1.9	1.7	1.4
	300	1.1	1.0	.8
	450	.9	.8	.7
	600	.8	.7	.6
	900	.7	.6	.5
	1500	.6	.5	.4

WALLS WITH PARTIAL OR FULL DEPTH INSULATION	CURRENT INSULATION				PARTIAL DEPTH	FULL DEPTH			PARTIAL DEPTH	FULL DEPTH			PARTIAL DEPTH	FULL DEPTH		
						HEIGHT ABOVE GRADE (MM)				HEIGHT ABOVE GRADE (MM)				HEIGHT ABOVE GRADE (MM)		
	RSI	BATTS MM	BEAD BOARD (MM)	BLUE BOARD (MM)	ALL HEIGHTS ABOVE GRADE	0-450	451-900	901-1500	ALL HEIGHTS ABOVE GRADE	0-450	451-900	901-1500	ALL HEIGHTS ABOVE GRADE	0-450	451-900	901-1500
	.7	–	25	–	1.7	2.5	2.4	2.2	1.5	2.2	2.1	1.9	1.3	1.9	1.8	1.6
	.9	–	–	25	1.8	2.9	2.7	2.5	1.6	2.6	2.4	2.2	1.4	2.2	2.0	1.8
	1.0	38	38	–	1.9	3.1	2.9	2.6	1.7	2.7	2.5	2.3	1.4	2.3	2.2	2.0
	1.4	64	50	40	2.1	3.7	3.5	3.1	1.8	3.3	3.1	2.8	1.5	2.8	2.6	2.4
	1.8	80	–	50	2.2	4.1	3.9	3.5	1.9	3.7	3.5	3.1	1.6	3.1	2.9	2.6
	2.1	98	76	–	2.3	4.5	4.3	3.9	2.0	4.0	3.8	3.4	1.7	3.4	3.2	2.9
	2.8	128	–	–	2.4	5.2	4.9	4.4	2.1	4.6	4.4	3.9	1.8	3.9	3.7	3.3
	3.5	160	–	–	2.5	5.8	5.4	4.9	2.2	5.0	4.8	4.3	1.9	4.3	4.1	3.7
BASEMENT FLOOR					100				7				7			
SLAB ON GRADE					–				–				4			

THERMAL RESISTANCES

TABLE B1 - THERMAL RESISTANCE OF SOME COMMON BUILDING MATERIALS*

Building Material or Component	Thermal Resistance			
	S.I.		imperial	
	R/mm	For Thickness Listed	R/in.	For Thickness Listed
Insulation				
Fibreglass Batt	0.022	---	3.17	---
Rockwool Batt	0.023	---	3.32	---
Fibreglass Loose Fill (Blown-In)	0.015	---	2.16	---
Fibreglass Loose Fill (Poured)	0.021	---	3.03	---
Rockwool Loose Fill (Blown-In)	0.019	---	2.74	---
Rockwool Loose Fill (Poured)	0.021	---	3.03	---
Cellulose Fibre (Blown)	0.025	---	3.61	---
Cellulose Fibre (Poured)	0.024	---	3.46	---
Expanded Mica (Vermiculite, Zonolite, etc.)	0.016	---	2.31	---
Polystyrene Loose Fill	0.020	---	2.88	---
Expanded Polystyrene (Rigid)	0.027	---	3.89	---
Extruded Polystyrene (Rigid)	0.035	---	5.05	---
Polyurethane (Rigid)	0.042	---	6.06	---
Polyurethane (Foamed in Place)	0.042	---	6.06	---
Fibreglass Sheathing	0.031	---	4.47	---
Urea Formaldehyde (Foamed in Place, After Curing)	0.018	---	2.60	---
Wood Fibre	0.023	---	3.32	---
Wood Shavings	0.017	---	2.45	---
Cork	0.026	---	3.75	---
Glass Fibre Roof Board	0.028	---	4.04	---
Mineral Aggregate Board	0.018	---	2.60	---
Compressed Straw Board	0.014	---	2.02	---
Fibreboard	0.019	---	2.74	---
Structural Materials				
Softwood Lumber (except Cedar)	0.0087	---	1.25	---
Cedar Logs and Lumber	0.0092	---	1.33	---
Concrete 2400 kg/m^3 (150 lb/ft^3)	0.00045	---	0.06	---
Concrete 1760 kg/m^3 (110 lb/ft^3)	0.0013	---	0.19	---
Concrete 480 kg/m^3 (30 lb/ft^3)	0.0069	---	1.00	---

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*Handbook on Insulating Homes for Energy Conservation, E. Scheuneman, S. Moffatt and M. Adelaar, Canadian General Standards Board, CGSB 51-GP-42MP, Ottawa, July 1980.

TABLE B1 - THERMAL RESISTANCE OF SOME COMMON BUILDING MATERIALS (Cont'd)

Building Material or Component	Thermal Resistance			
	S.I.		imperial	
	R/mm	For Thickness Listed	R/in.	For Thickness Listed
Structural Materials (Cont'd)				
Concrete Block (3 Oval Core)				
Sand and Gravel Aggregate				
100 mm (4")	---	0.12	---	0.68
200 mm (8")	---	0.20	---	1.14
300 mm (12")	---	0.22	---	1.25
Cinder Aggregate				
100 mm (4")	---	0.20	---	1.14
200 mm (8")	---	0.30	---	1.70
300 mm (12")	---	0.33	---	1.87
Lightweight Aggregate				
100 mm (4")	---	0.26	---	1.48
200 mm (8")	---	0.35	---	1.99
300 mm (12")	---	0.40	---	2.27
Common Brick, Clay, 100 mm (4")	---	0.07	---	0.40
Common Brick, Concrete, 100 mm (4")	---	0.05	---	0.28
Stone (Lime or Sand)	0.00060	---	0.09	---
Steel	0.000022	---	0.0032	---
Aluminum	0.0000049	---	0.0007	---
Glass (No Air Films) 3 - 6 mm (1/8" - 1/4")	---	0.01	---	0.06
Air				
Enclosed Air Space (Non-Reflective)				
Heat Flow Up, 25 - 100 mm (1" - 4")	---	0.15	---	0.85
Heat Flow Down, 25 - 100 mm (1" - 4")	---	0.18	---	1.02
Heat Flow Horizontal, 25 - 100 mm (1" - 4")	---	0.17	---	0.97
Air Surface Films				
Outside Air Film (Moving Air)	---	0.03	---	0.17
Inside Air Film (Still Air)				
Horizontal, Heat Flow Up	---	0.11	---	0.62
Sloping 45°, Heat Flow Up	---	0.11	---	0.62
Vertical, Heat Flow Horizontal	---	0.12	---	0.68
Horizontal, Heat Flow Down	---	0.16	---	0.91
Attic Air Film	---	0.08	---	0.45

TABLE B1 - THERMAL RESISTANCE OF SOME COMMON BUILDING MATERIALS (Cont'd)

Building Material or Component	Thermal Resistance			
	S.I.		imperial	
	R/mm	For Thickness Listed	R/in.	For Thickness Listed
Roofing				
Asphalt Roll Roofing	---	0.03	---	0.17
Asphalt Shingles	---	0.08	---	0.45
Wood Shingles (Cedar Shakes)	---	0.17	---	0.97
Built-Up Membrane (Hot Mopped)	---	0.06	---	0.34
Crushed Stone (Not Dried)	0.00055	---	0.08	---
Sheathing Materials				
Softwood Plywood	0.0087	---	1.25	---
Mat-Formed Particle Board	0.0087	---	1.25	---
Insulating Fibreboard Sheathing	0.017	---	2.45	---
Gypsum Sheathing	0.0062	---	0.89	---
Sheathing Paper	0.00040	---	0.06	---
Asphalt-Coated Kraft Paper	Negli.	---	Negli.	---
Polyethylene Vapour Barrier	Negli.	---	Negli.	---
Cladding Materials				
Fibreboard Siding				
Medium Density Hardboard, 11 mm (7/16")	---	0.10	---	0.57
High Density Hardboard, 11 mm (7/16")	---	0.08	---	0.45
Softwood Siding (Lapped)				
Drop, 18 × 184 mm (3/4" × 7 1/4")	---	0.14	---	0.79
Bevel, 12 × 184 mm (1/2" × 7 1/4")	---	0.14	---	0.79
Bevel, 18 × 235 mm (3/4" × 9 1/4")	---	0.18	---	1.02
Plywood, 9 mm (3/8")	---	0.10	---	0.57
Wood Shingles	---	0.17	---	0.97
Brick (Clay or Shale) 100 mm (4")	---	0.08	---	0.45
Brick (Concrete, Sand-Lime) 100 mm (4")	---	0.05	---	0.28
Stucco, 25 mm (1")	0.0014	0.03	0.20	0.17

TABLE B1 - THERMAL RESISTANCE OF SOME COMMON BUILDING MATERIALS (Cont'd)

Building Material or Component	Thermal Resistance			
	S.I.		imperial	
	R/mm	For Thickness Listed	R/in.	For Thickness Listed
Cladding Materials (Cont'd)				
Metal Siding				
Horizontal Clapboard Profile	---	0.12	---	0.68
Horizontal Clapboard with Backing	---	0.25	---	1.42
Vertical V-Groove Profile	---	0.12	---	0.68
Vertical Board and Batten Profile	---	Negli.	---	Negli.
Interior Finishes				
Gypsum Board, Gypsum Lath, Drywall, 13 mm (1/2")	0.0062	0.08	0.89	0.45
Gypsum Plaster				
Sand Aggregate, 13 mm (1/2")	0.0014	0.02	0.20	0.11
Lightweight Aggregate, 13 mm (1/2")	0.0044	0.06	0.63	0.34
Plywood, 7.5 mm (5/16")	0.0093	0.07	1.34	0.40
Hardboard, (Standard), 6 mm (1/4")	0.0053	0.03	0.76	0.17
Insulating Fibreboard, 25 mm (1")	0.017	0.42	2.45	2.38
Flooring				
Maple or Oak (hardwood), 19 mm (3/4")	0.0063	0.12	0.91	0.68
Pine or Fir (softwood), 19 mm (3/4")	0.0089	0.17	1.28	0.97
Plywood, 16 mm (5/8")	0.0088	0.14	1.27	0.79
Mat-formed Particle Board, 16 mm (5/8")	0.0088	0.14	1.27	0.79
Wood Fibre Tiles, 13 mm (1/2")	0.016	0.21	2.31	1.19
Linoleum, Tile (resilient), 3 mm (1/8")	---	0.01	---	0.06
Terrazzo, 25 mm (1")	0.00056	0.01	0.08	0.06
Carpet, Typical Thickness				
with Fibrous Underlay	---	0.37	---	2.10
with Rubber Underlay	---	0.23	---	1.31

LIST OF FURNACES AND BURNERS SUITABLE FOR RETENTION HEAD KIT

TABLE 1 : "F" CONVERSION KIT

Appliance Manufacturer	Appliance Model	Burner Model	Present Blast Tube	Blast Tube To Order
Aero Water Heaters	CF-32	FC-1	5½	8
	CF-50	FC-1	7	8
	CF-70	FC-1	8	8
	1000-30	F1-S	7	8
	1000-50	F2-S	7½	8
	1000-70	F2-S	9	11
Beach Foundry Limited	Carswell 98	F-98	10½	11
	Carswell 100	F-100	6 3/4	8
BP Canada	SEE AC-72-AC 123	BULLOCH F72-F123		
Archibald	SEE AC-72-AC 123.	BULLOCH F72-F123		
Bulloch's Ltd.	MF72/123	F72/123	7	8
Clare Brothers Limited	92-OHB	F92-145	8	8
	92-ODF	F145	8	8
	180-OLB	F180	8½	11
Clawsey-Sohrt	95-OL	F95-110	7	8
	110-OL			
	125-OL	F125-140	7	8
	95-110 S-CF	F95-110S	7	8
	125-140S	F125-140S	7	8
Cockram, Sumner and Westburne Industrial	OWC-300 320	F-300	5	8
	OWC-400 330	F-400	5	8

TABLE 1

"F" CONVERSION KIT
(continued)

Appliance Manufacturer	Appliance Model	Burner Model	Present Blast Tube	Blast Tube To Order
Kumfort Furnace (continued)	90 & 100 KSH-90	F-2	8	8
	75 & 100 KSD-100	F-2	8	8
	75 & 90	F-2	12	16
King Metal Prod.	W	FKM-1	5½	8
Lear and Seigler	MMG-82	F-a	4½	8
MacLeod	SEE BULLOCH	AC-72 AC-123		
Otaca Limited	L3-84A	F-3	5	8
	L3-95A	F-3	5	8
	L4-12	F-3	5	8
	LAU-95	F-4	5	8
	LAU-115	F-4	5	8
	CAU-90	F-1	8	8
	CAU-110	F-1	8	8
Reliable Industries	H-110	F1H-110	5½	8
	H-150	F2H-150	5½	8
S.O. Riverin & Co. Ltd.	11-01	F11-01	5½	8
	11-04	F11-04	5½	8
	11-06	F11-06	5½	8
Slant/Fin Ltd.	FO-5	F-SF-5	5½	8
	FO-6	F-SF-6	6	8
	FO-7	F-SF-7	6	8
	FO-8	F-SF-7	6	8
	M100/120	F-100	4½	8
	M150	F-150	4½	8
Space Conditioning of Canada Ltd.	FOL-85	F85-95	4½	8
	FOL-95		4½	8
	FOL-112	F112-133	4½	8

TABLE 1

"F" CONVERSION KIT
(continued)

Appliance Manufacturer	Appliance Model	Burner Model	Present Blast Tube	Blast Tube To Order
Furnasman Ltd. (continued)	LO-110		7½	8
	Mobile	FFM-65	4	8
	LO-130	F-2	9	11
	LO-160		9	11
	HO-95	FF95-110	7½	8
	LO-80	FF-91	6½	8
	LO-90		6½	8
Grimsby		CGF-1	7	8
		CGF-2	7	8
		CGF-3	7	8
		CSCF-1	7	8
		CSCF-2	7	8
		CSCF-3	7	8
		C979-CGF-1	7	8
		C979-CGF-2	7	8
		C979-CGF-3	7	8
	792	GF-1	6½	8
	796	GF-1	6½	8
	67-89	GF-1	6½	8
	67-100	GF-1	6½	8
	67-117	GF-1	6½	8
Hans-Starker	Carswell 115	F-115	10½	11
	Carswell 140	F-140	7½	8
	Aero 1000-30 OEM	F-1S	7	8
Grimsby	SC7-96	CSCF-1	6½	8
	SC7-89	CSCF-1	6½	8
	SC7-100	CSCF-1	6½	8
	SC7-117	CSCF-1	6½	8
Henlex Industries Ltd. (Hydrotherm)	OR-175	F-OR-175	5	8
	OR-210	F-OR-210	5	8
	OH-105	F-OH-105	4½	8
	OH-140	F-OH-140	4½	8
	OH-175	F-OH-175	4½	8
Hillis		F-1S	SEE FINDLAY	
Kumfort Furnace	KSC-75	F-2	6	8

TABLE 1

"F" CONVERSION KIT
(continued)

Appliance Manufacturer	Appliance Model	Burner Model	Present Blast Tube	Blast Tube To Order
Corkram, Sumner and Westburne Industrial (continued)	OWC-600 340	F-600	9	11
Corkram Company	COB-600	F-1S	5½	8
	COB-700	F-1S	5½	8
	COB-800	F-1S	5½	8
	500	F-500	5½	8
	500	F-500	5½	8
	500	F-500	5½	8
	500	F-515	5½	8
T. Eaton Co. Ltd.	AC-91	F1-91	7	8
	AC-107	F2-107	7	8
(see Bulloch)	AC-118	F2-118	7	8
Enamel and Heating Products	500 Boiler	F-500	5½	8
	500 Boiler	F-500	5½	8
	500 Boiler	F-500	5½	8
	500 Boiler	F-515	5½	8
	LO-85	F1-85	5	8
	LO-99	F-110	5	8
	LO-110	F-110	5	8
	LO-140	F-140	5	8
	LO-170	F-170	5	8
	PLO-86	FPLO-86	4½	8
	PLO-95	FPLO-95	4½	8
	6100-30 Water Heater	F-1S	6½	8
	6100-50 Water Heater	F-2	8	8
Findlays Limited	W-12	F72-140	7½	8
	07-9	F-079	6 7/8	8
Freco	WO-15	F-15	6	8
	WO-18	F-18	6	8
	WO-24	F-24	6	8
Furnasman Ltd.	LO-95	FF95-110	7½	8

TABLE 1

"F" CONVERSION KIT
(continued)

Appliance Manufacturer	Appliance Model	Burner Model	Present Blast Tube	Blast Tube To Order
Space Conditioning of Canada Ltd. (continued)	FOL-123		4½	8
	FOL-133		4½	8
Sumner Co. Ltd.	500	F-500	5½	8
	515	F-515	5½	8
	OWC-300	F-300	5	8
	320			
	OWC-400	F-400	5	8
	330			
	OWC-600	F-600	9	11
	340			
Supertest	SEE BULLOCH	AC-72 AC-123		
Thornes Hardware	KD-112	F-113-NY	5½	8
	KD-122	F-122-NY	5½	8
	KD-139	F-139-NY	5½	8
KD-145	KD-145	F-145-NY	5½	8
	KD-167	F-167-NY	6	8
	FO-5	F-SF-5	5½	8
	FO-6	F-SF-6	5½	8
	FO-7	F-SF-7	5½	8
	COB-600	F-1S	5½	8
	COB-700	F-1S	5½	8
	COB-800	F-1S	5½	8

TABLE 2

"C" CONVERSION KIT

Appliance Manufacturer	Appliance Model	Burner Model	Present Blast Tube	Blast Tube To Order
Chrysler Airtemp	BOL-84/95	CW-14	4 3/4	8
	BOL-112	CW-14	4 3/4	8
	BOL-138	CW-24	4 3/4	8
	BOL-160-185	CW-34	5 1/8	8
	BOS, BOH, BOC	CW-27	7 7/8	8
Conroy (Conversion Burners)		CP1-8	8	8
		CP1-12	12	16
		CP1-16	16	16
		CP2-8	8	8
		CP2-12	12	16
		CP2-16	16	16
		CP3-8	8	8
		CP3-12	12	16
		CP3-16	16	16
		CPV1-8	8	8
		CPV1-12	12	16
		CPV1-16	16	16
		CPV2-8	8	8
		CPV2-12	12	16
		CPV2-16	16	16
		CPV3-8	8	8
		CPV3-12	12	16
		CPV3-16	16	16
		CPG1-8	8	8
		CPG1-12	12	16
		CPG1-16	16	16
		CPG2-8	8	8
		CPG2-12	12	16
		CPG2-16	16	16
		CPG3-8	8	8
		CPG3-12	12	16
		CPG3-16	16	16
		CPGV1-8	8	8
		CPGV1-12	12	16
		CPGV1-16	16	16
		CPGV2-8	8	8
		CPGV2-12	12	16
		CPGV2-16	16	16
		CPGV3-8	8	8
		CPGV3-12	12	16
		CPGV3-16	16	16
		CPH1-8	8	8
		CPH1-12	12	16
		CPH1-16	16	16
		CPH2-8	8	8
		CPH2-12	12	16
		CPH2-16	16	16

TABLE 2

"C" CONVERSION KIT
(continued)

Appliance Manufacturer	Appliance Model	Burner Model	Present Blast Tube	Blast Tube To Order
Conroy (Conversion Burners) (continued)		CPH3-8	8	8
		CPH3-12	12	16
		CPH3-16	16	16
		CPHV1-8	8	8
		CPHV1-12	12	16
		CPHV1-16	16	16
		CPHV2-8	8	8
		CPHV2-12	12	16
		CPHV2-16	16	16
		CPHV3-8	8	8
		CPHV3-12	12	16
		CPHV3-16	16	16
Enterprise	PK87 & PK97	CWE-15	5 5/8	8
	PK117 & PK137	CWE-25	5 5/8	8
	LBO-195	CWE-36	6 5/8	8
		CWE-1-5000	5 3/8	8
		CWE-3-6000	6 5/8	8
	EF30 & EF32	CW-1		8
Gulf	GEL-84-95	EWL-14	4 1/8	8
	GEL-112	EWL-14A	4 1/8	8
	GEL-138	EWL-24	4 1/8	8
	GEL-160-185	EWL-34	4 1/8	8

APPENDIX 3

- ECAP HOME ENERGY SURVEY -

DRAFT COPY FOR

CLIENT INFORMATION PACKAGE

PREFACE

This draft provides preliminary copy for a client information package to support the ECAP home energy survey. It briefly explains the range of concepts and measures covered by the survey and serves as a link between the survey report left by the adviser and other information resources such as fact sheets, EMR books, and regional agencies to which the householder should be encouraged to refer.

The draft copy is intended for development purposes only. Time constraints have necessitated a general "first-cut" approach to the copy. Key issues have been highlighted but more detail on each measure is required to make the copy truly useful to the householder. Decisions are required on how an energy survey kit should be integrated with existing EMR publications and fact sheets on home energy conservation.

Decisions are also required on the approach to presenting an enhanced version of the copy within an attractive and effective communications format. Options which should be considered include text directly integrated in an expanded results presentation format (e.g., RCS or TVA systems), an accompanying illustrated brochure or set of fact sheets (e.g., Massave format), or a computer printout using the current copy as a set of standard paragraphs printed only when applicable (e.g., Cornerstones audit).

An effective and comprehensive information package is critical to the success of the energy survey program. Consequently information development must be made an immediate priority in planning for the implementation of a pilot program.

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NOTE: All drawings are from EMR publications unless otherwise indicated.

A. HOW TO FOLLOW UP ON YOUR HOME ENERGY SURVEY

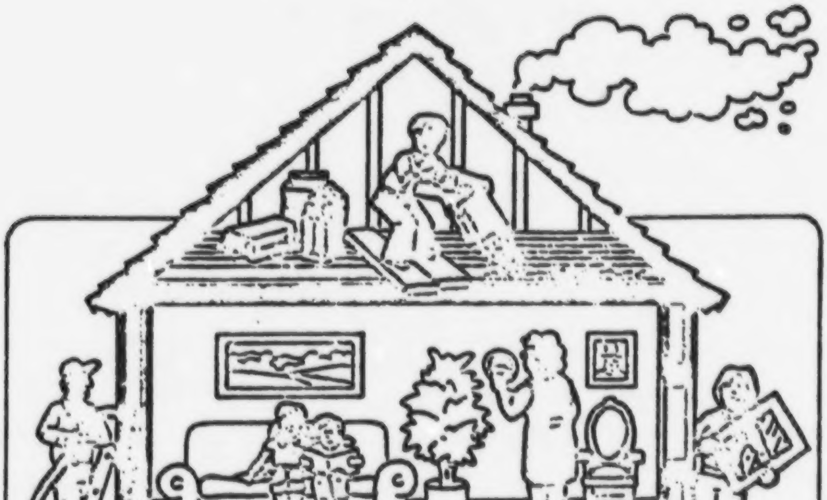
After a careful analysis of your home, our adviser has left you with a set of recommendations on the best ways to reduce your heating bill. To make the most of your analysis, you should take the following steps:

1. Study the Recommendations - Make sure you study the recommendations carefully - they'll help ensure you carry out the right projects for your home without paying too much for materials and services. If there's something you don't understand after the adviser has left, read over the accompanying sections which explain the energy survey and which provide a brief explanation of each recommendation. If you still need help, call our office.

2. Read the Supporting Material - Our books, Keeping the Heat In and the Billpayer's Guide to Furnace Servicing, cover the basics of home insulation and home heating. Use these books to familiarize yourself with the technical details of each recommendation before attempting to implement it. The fact sheets left by our adviser will also help. You'll find that it pays to be an informed consumer.

3. Develop a Plan of Action - In deciding what projects you will undertake, pay special attention to the priority assigned to each recommendation by the adviser. The high priority items should be done first since they represent the best investment for energy savings.

4. Compare Prices - Before buying materials make sure you compare prices. And if you're hiring a contractor make sure you



get a least three estimates from qualified firms. Use our cost estimates as guidelines to how much you should pay. And make sure you read our fact sheet on "How to Avoid Insulation Rip-Offs".

5. Follow Energy-Conserving Practices - Insulation and heating efficiency improvements will substantially reduce your heating bill. But you can increase your savings still further by improving the way you use energy in various household practices. The accompanying "Home Energy Conservation Checklist" will help you make improvements in this area.

HERE ARE THE RESULTS OF YOUR HOME ENERGY SURVEY

WHAT WAS ANALYSED		WHAT WE RECOMMEND	COST OF THE JOB		YOUR ANNUAL SAVINGS	PAYBACK IN YEARS	PRIORITY	REQUIREMENTS
			DO-IT YOURSELF	CONTRACTOR INSTALLED				
SEALING	WINDOW WEATHERSTRIP							
	DOOR WEATHERSTRIP							
	ENVELOPE CAULKING							
INSULATION	ATTIC							
	SIDE ATTIC							
	ROOF							
	WALL							
	FLOOR							
	FOUNDATION							
	ADDITIONAL WALL							
	STORM WINDOWS AND DOORS							
HEATING SYSTEM	THERMOSTAT SETBACK							
	CIRCULATION SYSTEM							
	TUNING AND SERVI							
	RETROFIT POTENTIAL							
	NOZZLE SIZE							
HOT WATER SYSTEM	TANK INSULATION							
	TEMPERATURE SETTINGS							
	FLOW RESTRICTORS							

REFERENCE INFO

CLIENT		
PROJECTED COSTS [illegible]	TOTAL HEATING COSTS	HOT WATER COSTS
HEATING SYSTEM	CURRENT EFFICIENCY	NOZZLE SIZE
MINIMUM NOZZLE SIZE	WITH TUNING	WITH RETROFIT
ADVISER		DATE

B. UNDERSTANDING THE RECOMMENDATION FORM

The adviser has concisely summarized the results of your energy survey on the recommendation form. To fully understand the form, you should be familiar with the following key terms which are used to organize information.

What Was Analyzed - By inspecting the exterior envelope of your home, the adviser pinpoints areas where heat loss can be reduced by sealing air leaks or by adding insulation. Your heating system and hot water system are also analyzed to determine ways to improve heating efficiency.

What We Recommend - The measures we suggest are designed to upgrade the thermal performance of each component of your home and heating system to the recommended minimum levels for your region. Before recommending any measure, the adviser checks to see that the work is technically possible and that it can be economically undertaken.

Cost of the Job - For each recommendation the adviser provides the estimated cost of implementation based on local prices for typical materials and services. The do-it-yourself costs are based on the cost of the basic materials you'll need to do the work. The contractor-installed costs cover both materials and labour. No do-it-yourself estimates are provided for those projects which we feel should only be undertaken by a qualified contractor or serviceman.

COSTLY
FUEL

Annual Savings - The estimated amount you'll save during the next heating season if you implement the recommendations. The savings estimates are based on our estimate of the price you'll be paying for fuel next year. As fuel prices rise in subsequent years your savings will grow even larger.

For comparative purposes, savings are calculated independently for each measure based on your current consumption. Total savings from a combination of insulation and heating system measures may be somewhat less than the sum of our estimates. For example the reduction in your heating bill after adding insulation will produce a proportionate reduction in savings from heating system measures. In most cases, the rising price of fuel will compensate for this effect.

Payback Period - The estimated number of years to recover your investment in a particular measure. It is calculated by dividing the cost of the job by the first year savings. This simple calculation provides a rough guide to the relative economic merits of each measure. Our payback estimates can be considered conservative since rising fuel prices will likely increase your savings in future years and hence reduce your payback.

Priority - The optimum sequence of implementation for the recommendations has been indicated by the adviser in the priority column. Recommendations have been priorized on the basis of payback in conjunction with the general principle that homes should first be sealed, then insulated, and finally heating efficiency adjusted to the new heating load.

Uneconomical - If the payback on any possible measure is more than 10 years the measure is considered uneconomical at the current time and is not recommended.

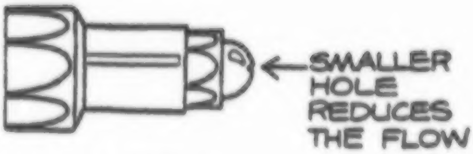
Grant Assistance - Since all measures are eligible for an ECAP grant, remember that you can greatly reduce your costs and hence reduce your payback period by obtaining grant assistance. Also note that a Canadian Home Insulation Program (CHIP) grant assistance may also be available to further reduce your costs. (For more information see our fact sheet on the CHIP grant). To be most effective, grant assistance should first be used to undertake the high priority items recommended by the adviser.

Maintenance Requirements - The adviser also specifies any maintenance measures which may need to be undertaken before implementing a specific recommendation. These measures are designed to ensure that the effect of our recommendation is not reduced or cancelled as a result of current problems such as moisture buildup or poor heating system performance.

Reference Information - Based on the analysis of your home the adviser provides basic reference information on projected fuel costs, heating system efficiency, and nozzle size in the right hand corner of your form.

Projected 1982-1983 Fuel Costs - The approximate cost of fuel for space heating and hot water heating during the 1982-83 heating season if you make no improvements. The space heating cost estimate is based on average winter conditions. Costs will be higher or lower if the heating season is colder or milder than usual. By taking the actions we recommend you can reduce your projected costs substantially.

Heating System Efficiency - The percentage of fuel which is currently converted into delivered heat by your heating system. Efficiencies of more than 75% are desirable. Lower efficiencies generally indicate the system needs improvement.


SMALLER HOLE REDUCES THE FLOW

OIL BURNER FUEL NOZZLE

SOURCE: The Super-Insulated Retrofit Book, Renewable Energy In Canada, Toronto, 1981.

Current Nozzle Size - The current size of your burner nozzle in U.S. gallons per hour. The nozzle determines the rate of flow of fuel into your heating system. In most systems, the nozzle size (or flow rate) is larger than necessary.

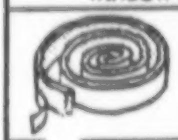
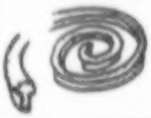
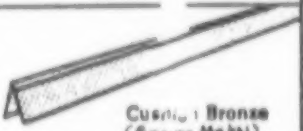
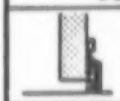
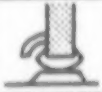
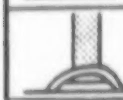
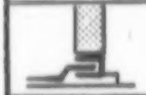
Minimum Nozzle Size - The minimum nozzle size which could be used in your system after cleaning and tuning or optimally after retrofit (if recommended). Compare the minimum size with your current size and discuss downsizing to a smaller nozzle with your serviceman.

Types of caulk.

CAULK TYPE	COST	LIFE	COMMENTS
Oil	Lowest	1-2 years	Can be painted, won't expand or compress with temperature changes
Butyl	Medium	5 years	Can be painted, expands and contracts
Acrylic Latex	Medium	5 years	Can be painted, expands and contracts
Silicone	High	10-20 years	Can't be painted, will expand or contract with temperature changes, comes colored

Fill large cracks with oakum, caulking cotton, or fiberglas, then caulk to seal out water. Caulk all cracks where siding touches windows, doors, & chimney. Sills leak air. Pay attention there.

Weatherstripping

WINDOW AND DOOR	COST	LIFE	COMMENTS
 Foam Rubber Adhesive Back	Lowest	1-2 Year	Wears with friction & sunlight Use only on window top & bottom
 Roll Vinyl	Medium	5 Year	Use in middle of double hung windows Destroyed by painting
 Cushion Bronze (Spring Metal)	High	10-20 Year	Recommended Best seal Bronze tacks or nails required
DOOR THRESHOLD	**COST**	**LIFE**	**COMMENTS**
 Adjustable Sweep	Lowest	1-2 Year	Recommended May drag on carpets Adjustable, easiest to install
 Door Shoe	Medium	5 Year	Requires moderate skill
 Vinyl Bulb Threshold	Medium	5-10 Year	Requires moderate skill
 Interlocking Threshold	High	10-20 Year	Best Seal Difficult to install

SOURCE: The How To Guide For Home Energy Savings,
Cornerstone Energy Group, Brunswick, Maine, USA, 1981

C. ENERGY CONSERVATION MEASURES COVERED BY THE ENERGY SURVEY

The following description of the measures covered by the energy survey explains exactly what measures were considered by the adviser in assessing your home. It also explains how to follow-up on the measures which the adviser determined were applicable to your home as specified on your recommendation form.

1. SEALING MEASURES

The uncontrolled entry of cold air and escape of warm air can account for up to 40% of heat loss in a typical Canadian home. Therefore reducing heat loss by sealing air leakage sites with inexpensive caulking and weatherstripping materials should be a first priority.

The energy survey divides sealing recommendations into the following categories:

(a) Caulking and Weatherstripping Doors and Windows - The adviser has identified the approximate number of doors and windows which require weatherstripping around the moving parts. Information on how to select and install weatherstripping materials is provided on page 83 of Keeping the Heat In. In general, it is worth the extra expense to install quality high durability weatherstripping such as the spring metal or vinyl types. Also take care to repair broken panes and to caulk around leaky window panes if necessary.

(b) Sealing the Building Envelope - The adviser has also identified if the attic, wall or foundation area of your building envelope appear leaky, and if they are accessible for you to seal. All cracks through which heat can escape should be sealed in each area.

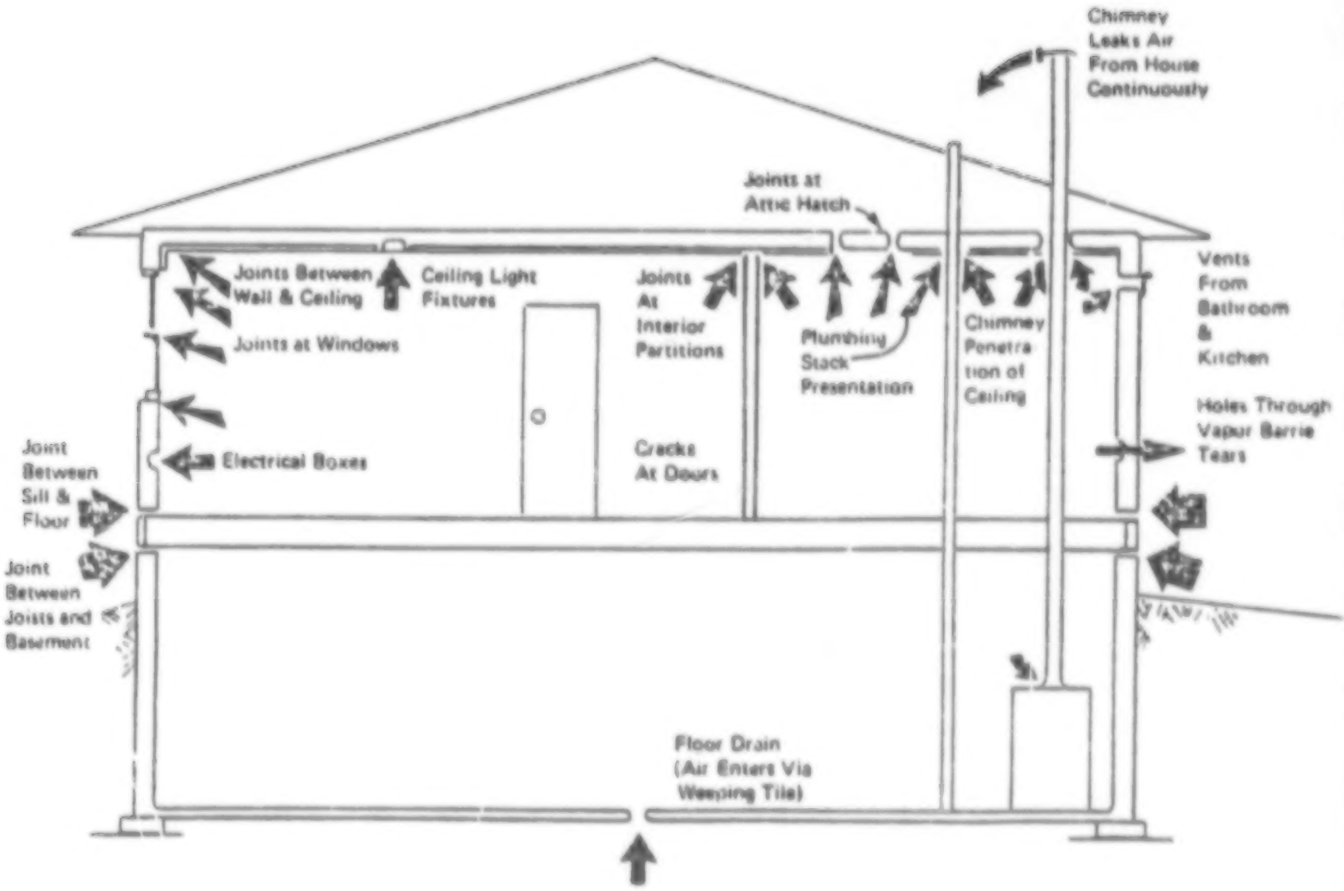

Chimney Leaks Air From House Continuously
Joints at Attic Hatch
Joints Between Wall & Ceiling
Ceiling Light Fixtures
Joints At Interior Partitions
Plumbing Stack Presentation
Chimney Penetra tion of Ceiling
Vents From Bathroom & Kitchen
Joints at Windows
Electrical Boxes
Cracks At Doors
Holes Through Vapur Barrie Tears
Joint Between Sill & Floor
Joint Between Joists and Basement
Floor Drain (Air Enters Via Weeping Tile)

FIGURE 5.2
AIR LEAKAGE SPOTS IN CONVENTIONAL CONSTRUCTION

SOURCE: The Handbook On Insulating Homes For Energy Conservation, Canadian General Standards Board, Hull, P.Q. 1980

In the attic area, unfaced batts should be used to plug all gaps providing an escape route from the heated area of your home (e.g., around the chimney, plumbing stack, electrical wiring holes, ducts or pipes, dryer vents, light fixtures, exhaust fans). Tops of interior and exterior wall cavities should be stuffed with batts. Cracks in the ceiling should be sealed and the attic hatch should be weatherstripped and insulated.

Use highly flexible long-lasting caulking materials to seal the walls around the living area of your home. Sealing should cover all cracks around window and door frames, ceiling and baseboard mouldings, around sink and bathtub plumbing, door threshholds, dryer vents or exhaust fans; fireplace dampers and ceiling fixtures. Leaks around electrical wall outlets and light switches can be sealed after power has been turned off by using special gaskets available at your local dealer.

Foundation leaks may also need to be plugged. Leakage frequently occurs around the sill plate on your foundation wall. Other areas include the junction between joists and the wall, around the base of the chimney, into the main floor wall cavity, around doors in the cold storage or furnace room, or around electrical conduit, pipes, vents, wiring, and plumbing connections to the exterior or to wall partitions.

Sealing work is an ideal do-it-yourself project and our fact sheet on How To Detect and Seal Air Leaks can help you get started. Alternatively, a growing number of firms can offer you sealing services on a commercial basis.

Thermal Resistance Values

Material	R/inch	RSI/ mm
Fibreglass batt	3.17	.022
Rock wool batt	3.32	.023
Fibreglass loose (blown)	2.16	.015
Fibreglass loose (poured)	3.03	.021
Rock wool loose (blown)	2.74	.019
Rock wool loose (poured)	3.03	.021
Cellulose (blown)	3.61	.025
Cellulose (poured)	3.46	.024
Vermiculite	2.31	.016
Polystyrene (loose)	2.88	.020
Expanded Polystyrene	3.89	.027
Extruded Polystyrene	4.62	.032
Polyurethane (rigid or foamed)	6.06	.042
Fibreglass sheathing	4.47	.031
Wood fibre	3.32	.023
Wood shavings	2.45	.017
Glass fibre roof board	4.04	.028
Mineral aggregate board	2.60	.018
Fibreboard	2.74	.019

SOURCE: The Super-Insulated Retrofit Book, Renewable Energy in Canada, Toronto, 1981

2. INSULATION MEASURES

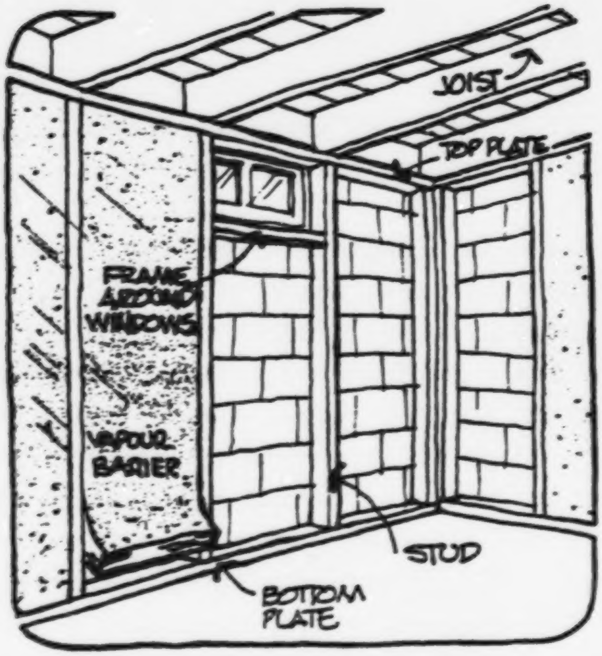
Here is a list of some key terms which you'll need to be familiar with to understand our insulation recommendations.

(a) RSI-values - All insulation recommendations are designed to tell you how much insulation you should add in terms of a particular RSI-value (e.g., add 'RSI 3.5'). The RSI-value is a measure of the resistance of an insulating material to heat flow. The higher the RSI-value, the greater the resistance. The RSI-values the adviser suggests are designed to increase your insulation levels to the minimum values recommend for homes in your region. Since each insulating material has a different RSI-value per unit of thickness, make sure the material you select is added at a sufficient thickness to give you the required RSI. Your dealer can help you with this.

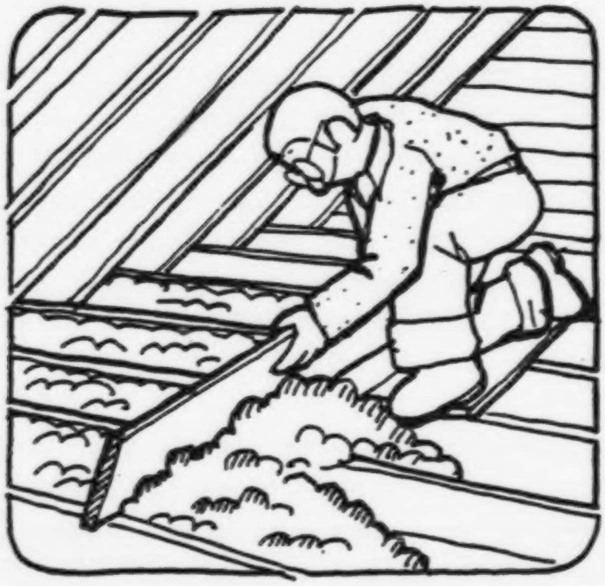
NOTE: The RSI-value is a metric unit. Some insulation materials may also be marked with an R-value. (e.g. R-20) which is the British unit. Make sure you specify RSI-units to your dealer.

(b) Technical Assessment - Before considering an insulation recommendation the adviser inspects your home to ensure that there are no structural or moisture problems which would prevent the addition of insulation. The adviser also notes if any maintenance work should be done before insulation is installed and enters that information on your recommendation forms. See Section D for an explanation of the maintenance measures considered by the adviser.

(c) Economic Assessment - To determine if additional insulation is economical, the adviser checks the current level of insulation in each area of your home during the inspection. Additonal insulation will be recommended only if the cost of the insulation will be paid back in energy savings within 10 years. For this reason,


JOIST
TOP PLATE
FRAME AROUND WINDOWS
VAPOUR BARRIER
STUD
BOTTOM PLATE

INSULATING THE BASEMENT WALL



INSULATING THE ATTIC

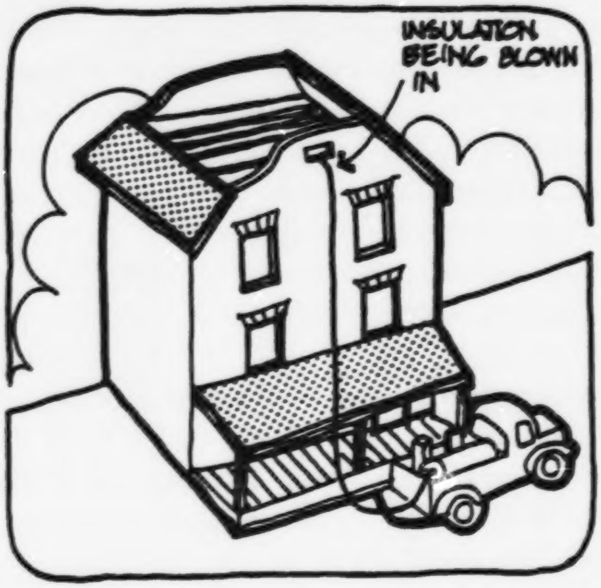
insulation is not recommended for roof, floor, and foundation areas which already contain insulation since insulating these areas is expensive and the payback is currently more than 10 years. Similarly, insulation will not be recommended for attic areas which contain more than RSI 3.9 insulation since the cost of adding the relatively small amount of insulation required to reach the recommended level of RSI 5.6 is not normally returned in energy savings within 10 years.

(d) Foundation Insulation - Where feasible, the adviser will recommend foundation insulation which involves adding RSI 2.1 to basements, walls or crawl spaces. Foundation insulation for slab-on-grade homes will be recommended only where there is easy access for insulating around the perimeter of the slab.

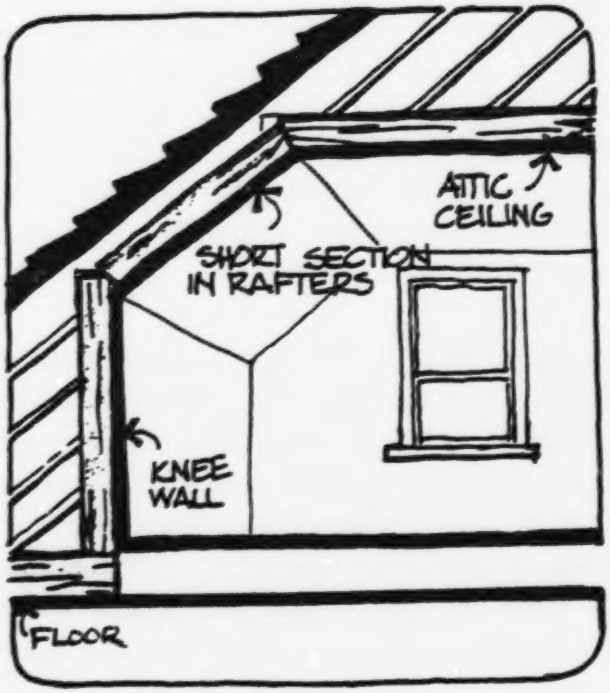
Basement insulation costs are based on installing batt insulation within a 2 X 4 stud wall and applying a dry wall finish. Costs will be considerably cheaper if you do not require a finished wall since foil-faced batt insulation can simply be hung in place. Rigid board insulation is a further alternative.

Foundation insulation is often a major source of heat loss in Canadian homes and is commonly a high priority area for re-insulation. For information on how to insulate foundations see Keeping the Heat In, page 58.

(e) Attic Insulation - Where feasible, the adviser will recommend sufficient insulation to increase the insulation level to the recommended RSI 5.6. For the purposes of the survey, an attic refers to any "easily accessible" areas adjacent to your roof space. By easily accessible, we mean that there is room for someone to get into the area and insulate it. For details on how to insulate you attic, see Keeping the Heat In, page 43.


INSULATION BEING BLOWN IN

INSULATING THE ROOF SPACE


ATTIC CEILING
SHORT SECTION IN RAFTERS
KNEE WALL
FLOOR

SIDE ATTIC INSULATION

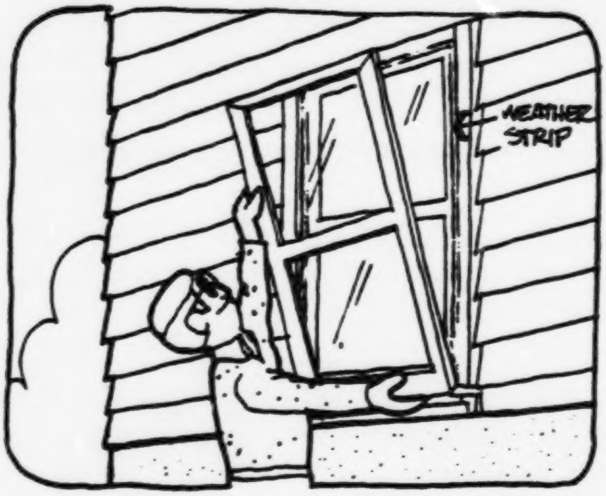
(f) Roof Insulation - Roof insulation typically applies to homes with flat roofs or cathedral ceilings. However, it generally refers to any part of your roof space that is not easily accessible (i.e. that is not large enough for a person to get into and insulate like an attic). Where feasible, the adviser will recommend adding RSI 3.5. Roof insulation is a complicated job and should only be undertaken by a qualified contractor. See page 56 of Keeping The Heat In, for insulation details.

(g) Side Attic Insulation - Homes with half-storeys generally have side attics which also must be insulated. The adviser treats the floor of the side attic in the same manner as the main attic. The "knee wall" and rafter space areas are treated the same as for roof areas. For details on how to insulate side attics see Keeping The Heat In, page 52.

(h) Main Wall Insulation - Where feasible, the adviser will recommend increasing wall insulation by filling the cavity with blown loose fill insulation. For standard cavities this will provide about RSI 2.1 level of insulation. Wall insulation is a complicated job and should only be undertaken by a qualified contractor. See Keeping The Heat In, page 73 for details.

(i) Added Wall Insulation - This refers to the walls of any heated enclosure which has been added to the original living space and which differ structurally or in insulation from the main walls. Added walls are analyzed in the same manner as your main walls.

(j) Floor Insulation - This refers to any area of your floor space which is directly exposed to the outdoors (heated sunporch, canti-levered floor) or which is built over an unheated


WEATHER STRIP

INSTALLING STORM WINDOWS

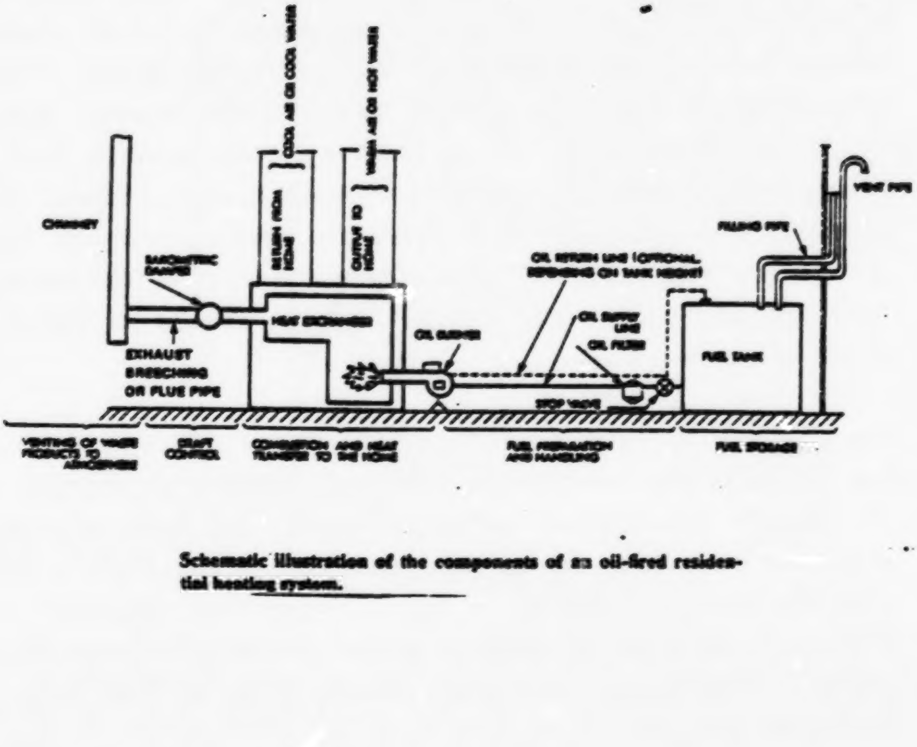
space. Where feasible the adviser will recommend increasing floor insulation to the recommended level of RSI 4.6. See Keeping The Heat In, page 78 for insulation details.

(k) Insulating Materials - There are a number of available insulating materials and the type you select will depend on the area you want to insulate. See page 42 of Keeping the Heat In for a description of each type of insulation and their recommended applications. You can also discuss appropriate materials for particular jobs with your dealer.

(l) Storm Windows - To correct unnecessary heat loss through your windows, the adviser will recommend that you install storms on single-pane windows during winter months. Our cost estimates are based on quality metal-frame storms. However, if you prefer, the job can be done at considerably less expense by installing plastic "snap-in-place" inside storms. For more information, read our fact sheet on windows and see pages 79 in Keeping The Heat In. Also discuss storm window options with your dealer. In general buying quality storms is worth the extra expense.

(m) Thermal Doors - To reduce heat loss through your doors. the adviser will recommend that you install a thermal door on all single non-thermal exterior doors. Our cost estimates are based on a quality 50 mm wood door and frame with a urethane core which will provide an RSI 2.1 level of insulation. Optionally you may wish to install storm doors which are cheaper but offer a much lower RSI-value. Check Keeping The Heat In, page 80 for more details.

NOTE: Storm windows and thermal doors do not qualify for an ECAP grant.


COOL AIR OR COOL WATER
WARM AIR OR HOT WATER
RETURN FROM HOME
OUTPUT TO HOME
CHIMNEY
BAROMETRIC DAMPER
HEAT EXCHANGER
EXHAUST
BREECHING
OR FLUE PIPE
OIL BURNER
OIL RETURN LINE (OPTIONAL, DEPENDING ON TANK HEIGHT)
OIL SUPPLY LINE
OIL FILTER
STOP VALVE
FUEL TANK
FILLING PIPE
VENT PIPE
VENTING OF WASTE PRODUCTS TO ATMOSPHERE
DRAFT CONTROL
COMBUSTION AND HEAT TRANSFER TO THE HOME
FUEL PREPARATION AND HANDLING
FUEL STORAGE

Schematic illustration of the components of an oil-fired residential heating system.

3. HEATING SYSTEM MEASURES

The heating system recommendations are based on the adviser's assessment of the current conditon, efficiency, and capacity of your heating system. The measures considered by the adviser are listed below. For more information read our book The Billpayer's Guide to Furnace Servicing.

(a) Thermostat Setback - If your current settings are above the currently recommended levels of 68°F during the day and 63°F at night or when the house is not occupied, the adviser will recommend that you reduce or "setback" your thermostat to these levels. To ensure a regular and accurate setback schedule, we recommend you install an automatic setback device. The cost of these devices normally can be recovered in energy savings within a year or two and is more than justified by the added convenience and consistency in operation. These devices use either mechanical or electrical timers to operate the thermostat at the optimum temperatures you select.

(b) Servicing - If your oil heating system has not been serviced in more than a year or if specific maintenance work is needed, the adviser will recommend that you have a qualified serviceman perform a complete service job. The service should include a thorough inspection, safety check, lubrication and cleaning of the system. Also ask your serviceman to pay special attention to any maintenance requirements noted by the adviser.

More specifically the servicing should involve the following tasks:

- cleaning of heat exchanger and combustion chamber
- inspection of oil pump system
- replacement of oil filter
- inspection of operating and safety controls such as thermostat, on-off switches, aquastat or fan controls

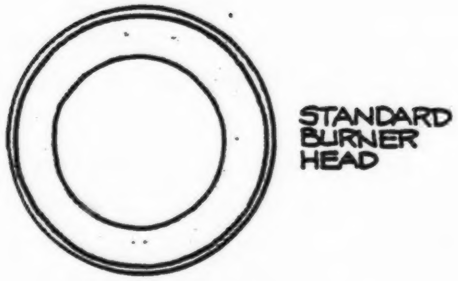
- lubrication of pump and blower motors
- cleaning of air filters and fan blades (if applicable)
- cleaning and lubrication of burner unit (fan motor, electrodes and transformer)
- replacement of nozzle (annually)
- sealing of air leaks into the unit
- inspection and adjustment (or replacement) of barometric draft regulator
- inspection of circulation system

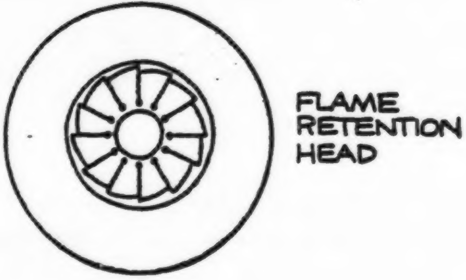
(c) Tuning - If the efficiency of your heating system indicates that components are out-of-tune, the adviser will recommend than an instrumented tuning be carried out by the serviceman at your next servicing. By adjusting the smoke and draft controls to optimum levels, the serviceman should be able to improve the system's efficiency by at least 5%.

A furnace tune-up is an additonal service to the annual cleaning and servicing offered by service companies. Tuning is based on careful measurement of the smoke, carbon dioxide levels and stack temperature of your system to determine operating efficiency for the system. The serviceman should perform the measurements after each tuning adjustment until an optimum efficiency is achieved. The final readings measured by the serviceman should be left on a tag attached to your system.

(d) Delayed Action Solenoid Valve - If your system does not already have one, the adviser will recommend that your serviceman install a "delayed action solenoid valve". The valve improves the synchronous action of fuel oil injection and the fuel ignition system which makes your system run more cleanly and therefore more efficiently.

(e) Circulation System - If you have a forced air system, the adviser checks for possible improvements in your air circulation fan settings. If you have a hot water system, the adviser checks to see if you require a circulating pump.


STANDARD
BURNER
HEAD


FLAME
RETENTION
HEAD

SOURCE: The Super-Insulated Retrofit Book, Renewable Energy in Canada, Toronto, 1981

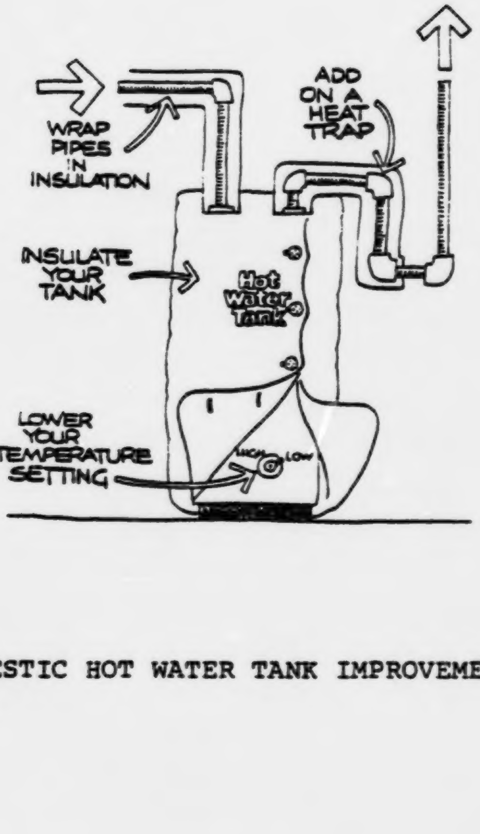
(i) Fan Settings (Forced Air Systems Only)- The settings on your air circulation fan control the temperature at which the fan turns on (the higher temperature) and turns off. It has been shown that the optimum settings for energy-efficiency are 120°F and 90°F. If your current settings are above this level, the adviser will recommend you ask your serviceman to lower them for you at the next servicing.

(ii) Circulating Pump (Hydronic Systems Only) - If your hot water system currently has no circulating pump the adviser will recommend you install one. Major savings can be achieved since the pump significantly improves your heating system's efficiency in distributing heat throughout your home.

(f) Retrofit Potential - If your heating system is operating at less than 75% (less than 68% if it also needs tuning), the adviser will suggest you boost system efficiency to at least 80% by installing a retention head kit which is designed to make an older burner operate more efficiently through a better mixing of the oil and the combustion air. Alternatively, if your system cannot be fitted with any of the available retention kits, the adviser will recommend a new high-efficiency burner which should also offer more than 80% efficiency. More information is provided in our fact sheet "Retrofit Measures for Oil Heating Systems".

If the system is more than 16 years old, the adviser will not recommend a retention head kit or replacement burner but instead may suggest that you consider switching to a newer high efficiency unit. More information is provided in our fact sheet on "How To Choose A New Oil-Fired Heating System".

(g) Downsizing - Many Canadian homes currently waste energy due to oversized burner nozzles. The nozzle controls the rate at


WRAP PIPES IN INSULATION
ADD ON A HEAT TRAP
INSULATE YOUR TANK
Hot Water Tank
LOWER YOUR TEMPERATURE SETTING
HIGH
LOW

DOMESTIC HOT WATER TANK IMPROVEMENTS

SOURCE: The Super-Insulated Retrofit Book, Renewable Energy in Canada, Toronto, 1981

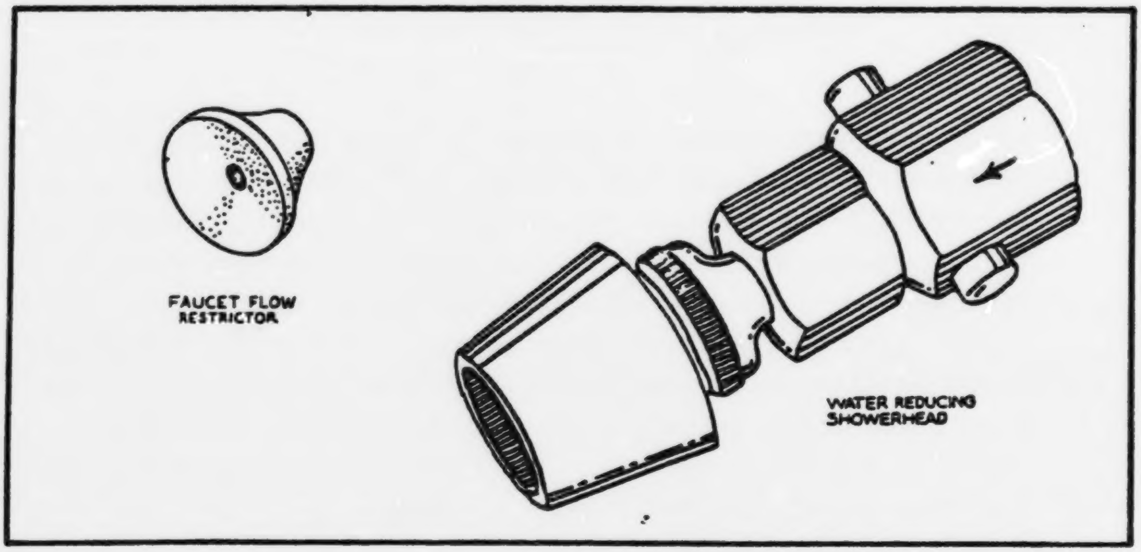
which your heating oil is burned. If after performing simple heat load calculations the adviser finds that your system is burning oil too rapidly, "downsizing" to a smaller nozzle will be recommended. Minimum nozzle sizes are specified for downsizing after a thorough cleaning and tuning if required or after system retrofit is recommended. Discuss the downsizing recommendation with your serviceman. A smaller nozzle can be easily and inexpensively installed during normal servicing which in any event typically includes nozzle replacement (but not downsizing] for maintenance purposes.

4. DOMESTIC HOT WATER MEASURES

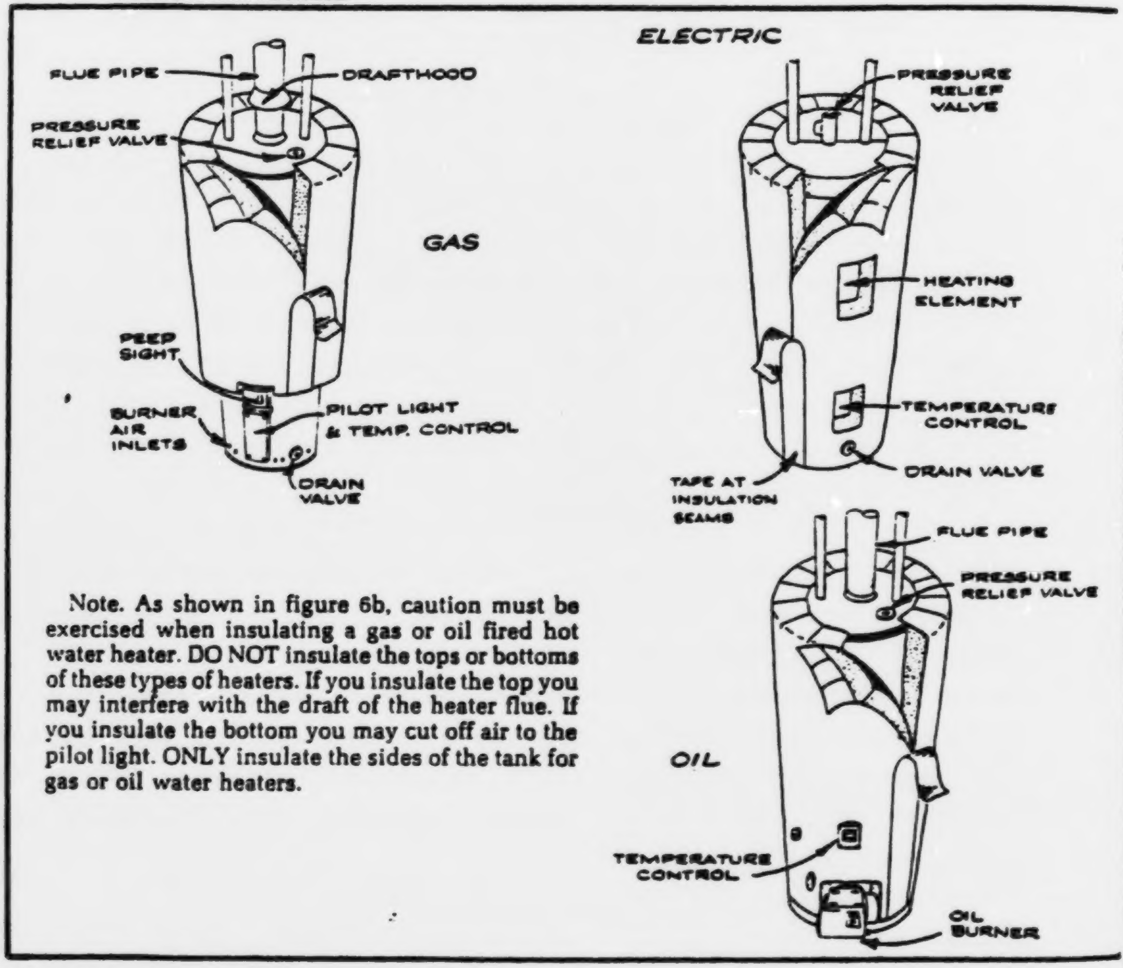
The rapid rise in fuel prices in recent years has made domestic hot water an expensive item and underlines the need for savings. Based on an estimate of your current hot water consumption, the adviser has calculated that your hot water bill will rise over the next year to approximately the level shown on the recommendations page if no measures are taken. To help you reduce your bill, the adviser may recommend any of the measures listed below depending on the results of his inspection. For more information, read our fact sheet "How To Reduce Your Hot Water Heating Costs".

(a) Lower Temperature Setting - Many households waste energy by "overheating" their hot water. For most homes, a temperature of 49°C (120°F) is adequate. The adviser has measured your hot water temperature and if it is above 49°C, will recommend a reduction to that level. (Conventional dishwashers may require a higher setting of 60°C (140°F) which will somewhat reduce the possible savings: however, newer "energy-efficient" models are being designed for the 49°C level.

Water saving devices.


FAUCET FLOW RESTRICTOR
WATER REDUCING SHOWERHEAD

Hot water tank insulation.


ELECTRIC
FLUE PIPE
DRAFTHOOD
PRESSURE RELIEF VALVE
GAS
PEEP SIGHT
BURNER AIR INLETS
PILOT LIGHT & TEMP. CONTROL
DRAIN VALVE
PRESSURE RELIEF VALVE
HEATING ELEMENT
TEMPERATURE CONTROL
DRAIN VALVE
TAPE AT INSULATION SEAMS
FLUE PIPE
PRESSURE RELIEF VALVE
OIL
TEMPERATURE CONTROL
OIL BURNER

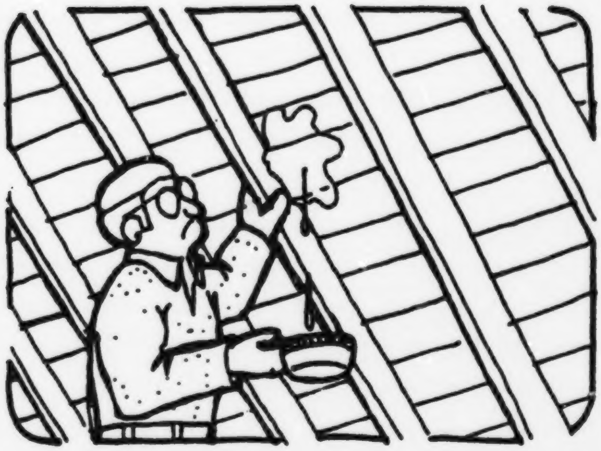
Note. As shown in figure 6b, caution must be exercised when insulating a gas or oil fired hot water heater. DO NOT insulate the tops or bottoms of these types of heaters. If you insulate the top you may interfere with the draft of the heater flue. If you insulate the bottom you may cut off air to the pilot light. ONLY insulate the sides of the tank for gas or oil water heaters.

SOURCE: The How To Guide For Home Energy Savings, Cornerstones Energy Group, Brunswick, Maine, 1981 (Both Drawings)

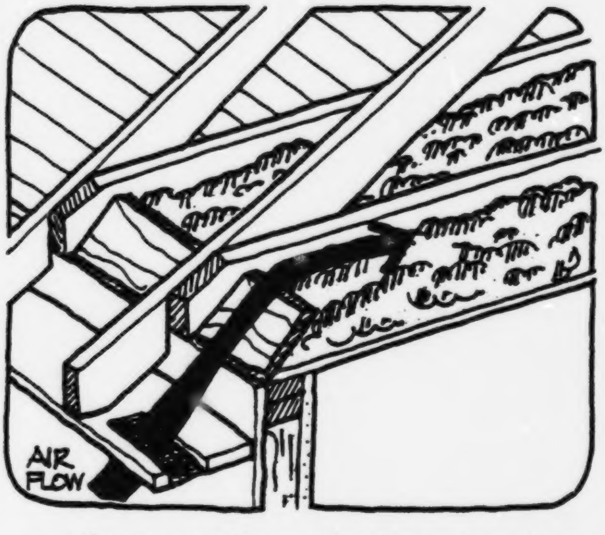
Since hot water thermostats are often inaccurate, we suggest you buy a thermometer capable of operating in the 120° - 160°F range and measure your hot water temperature at the tap. Then lower the thermostat until you reach the desired 120°F level.

(b) Increase Tank Insulation to RSI 3.5 - If your hot water tank currently has only 50 mm of insulation or less and can be insulated economically, the adviser will recommend adding insulation to achieve the recommended level of RSI 3.5. Most building supply or hardward stores sell easy-to-install hot water insulation kits.

(c) Install Flow Restrictors On Faucets and Showerheads - Hot water use can be reduced by up to 40% by installing flow restrictors on showerheads and kitchen and bathroom faucets. Where warranted, our adviser will recommend restrictors provided they are adaptable to your system. The restrictors are easy to install since they screw directly into the shower or faucet pipe.



Check for leaks in the roof — wetness or water stains. If there are any, repair them first.



— at the eaves, caution must be taken to keep the insulation from blocking the ventilation and/or disappearing into the eave space. Batt insulation or a wood baffle may be used.

D. MAINTENANCE MEASURES COVERED BY THE ENERGY SURVEY

The adviser has assessed your home for the following possible maintenance requirements and specified those measures you will need to undertake before doing "retrofit" work in the indicated area.

1. BUILDING ENVELOPE MAINTENANCE

(a) Reduce Humidity - This is recommended if the moisture level in your home appears to be excessive. To avoid condensation problems which could damage the structural components of your building envelope, you should reduce moisture production in your home and ensure that an adequate vapour barrier is installed. More information is available in our fact sheet, "How To Avoid Condensation Problems".

2. EXTERIOR MAINTENANCE

(a) Repair Roof - Problems such as poor shingles, inadequate flashing or poor stability should be repaired before insulating. A properly maintained roof will protect your home from structural damage and keep your insulation dry.

(b) Repair Soffits - For homes with soffit ventilation, poor soffit troughs or any peeling or rotting in the soffit system should be repaired. This will ensure a long-lasting and effective source of ventilation as a protection against moisture problems.

(c) Repair Vents - Problems such as blocked vents or inadequately positioned vents should be corrected to provide adequate ventilation protection.

ELIMINATE MOISTURE PROBLEMS

E. SIDE ATTIC, ROOF AND FLOOR AREAS

(a) Repair Moisture Problems - This will be recommended if there is evidence of excessive moisture build-up in the area to be insulated. The source of the moisture must be identified and eliminated to prevent damage to structural components and insulation materials. Our fact sheet on "How To Avoid Condensation Problems" may help you deal with the problem.

(b) Improve Existing Insulation - Your existing insulation may need to be more evenly spaced over the insulated area or better fitted around component details to ensure adequate coverage.

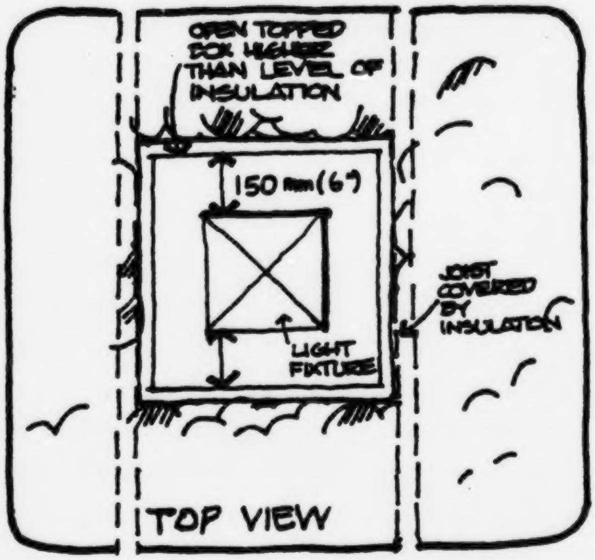
C. WALLS

(a) Repair Moisture Problems - If the adviser has identified a moisture problem in your wall, first check the wall surfaces and repair any leaks which may allow moisture to enter the wall cavity. Then check for and repair any exterior leaks which may allow moisture penetration from the outside. The moisture problem must be eliminated before insulating to avoid damage to structural components or insulating materials.

(b) Repair Structural Problems - Structural problems such as major holes, structural deterioration or instability must be repaired before insulating to ensure a long-lasting insulation job.

D. FOUNDATION

(a) Repair Moisture Problems - This is recommended if there is evidence of excessive moisture build-up within your foundation assembly. The source of the moisture must be identified and eliminated to prevent damage to the foundation and insulating materials.


OPEN TOPPED BOX HIGHER THAN LEVEL OF INSULATION
150 mm (6")
LIGHT FIXTURE
JOIST COVERED BY INSULATION
TOP VIEW

If you have a recessed lighting fixture that has already been covered with insulation, climb into your attic, remove the insulation, and proceed as above.

excess moisture before problems can occur. For more information read our fact sheet on "Attic Ventilation After Reinsulation, and page 18 of "Keeping the Heat In."

(b) Replace Damp Insulation - Damp insulation is ineffective and must be replaced. Make sure to locate and eliminate the source of the moisture.

(c) Improve Existing Insulation - Your existing insulation may need to be levelled or to be better placed around attic components (e.g. attic hatch) to ensure adequate coverage.

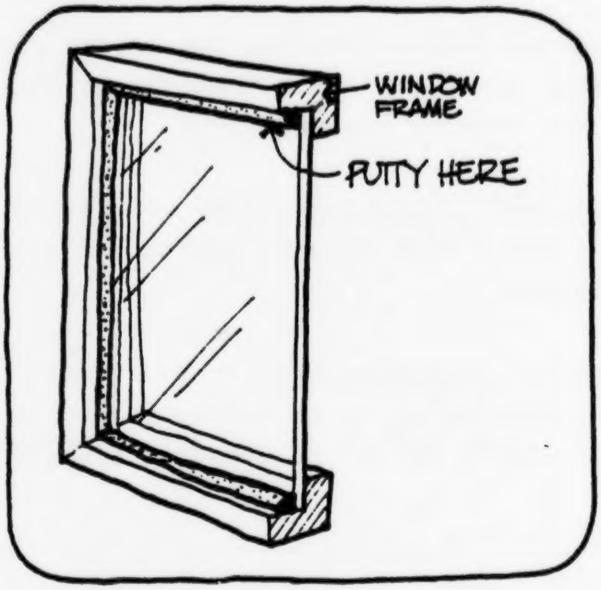
(d) Replace Missing Insulation - Missing insulation gives heat an easy escape route. Make sure any gaps in your attic insulation blanket are filled.

(e) Protect Recessed Lights or Fan Motors - Recessed lights or fan motors have the potential for producing dangerously high temperatures. To avoid a fire hazard such units should not be covered and insulation should be kept 3" away. Read our fact sheet on "Attic Fire Hazards" for more information.

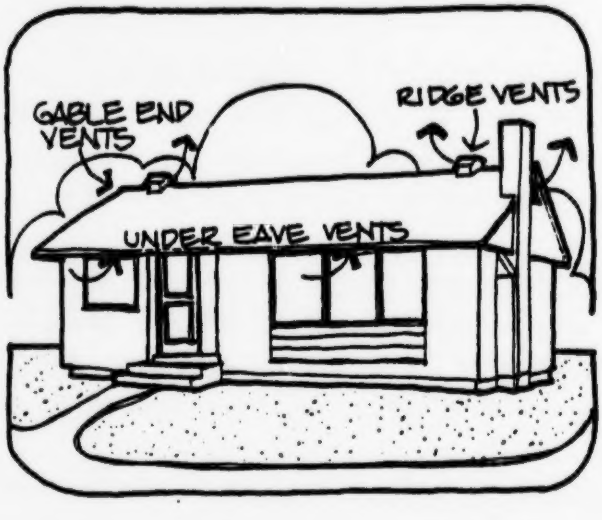
(f) Improve Attic Ductwork - The ductwork in your attice may need improvement. Have your heating serviceman eliminate unnecessary runs or bends. Also ask him to tape joints to avoid unnecessary leakage at joint cracks.

(g) Improve Electrical Wiring - Problems with your electrical wiriing could be aggravated by adding insulation. Wiring that is exposed, frayed, cracked or corroded should be checked immediately by your electrical utility inpection or a licensed electrician.

(h) Add Additonal Rafter Support - Adding insulation will reduce the temperature of your roof which may lead to increased winter snow build-up. As a result, your roof may need additional rafter support. Consult a qualified tradesman.


WINDOW FRAME
PUTTY HERE

TIGHTENING LOOSE PANES


GABLE END VENTS
RIDGE VENTS
UNDER EAVE VENTS

VENTILATION SYSTEMS

(d) Repair Chimney - Problems such as loose masonry, a damaged cap, poor clearances or soot build-up should be repaired. A properly maintained chimney will ensure optimal performance of your heating system.

(e) Repair Sidings - Problems due to unfinished area, peeeling, leaks, or poor stability should be repaired to ensure that wall structural components and insulating materials are adequately protected.

(f) Repair Windows - Problems such as loose storms, broken panes or poor caulking should be corrected to avoid unnecessary heat loss through your windows.

(g) Repair Foundation - Problems such as cracks, leaks or loose masonry should be repaired. A properly maintained foundation will protect your home from structural damage and keeep your insulation dry.

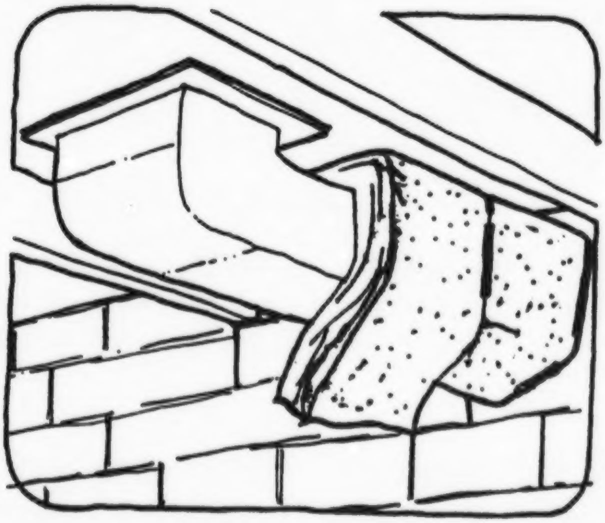
(h) Improve Insulation - Poor drainage allows water to enter the foundation area leading to potentially serious moisture problems. Make sure your drainage system directs water away from your foundation on all sides to keep your foundation and insulation dry.

(i) Repair Fill Pipe - Problems such as leaks, a poor cap or a poor seal should be repaired to avoid problems with your fuel delivery system.

3. INSULATION AREA MAINTENANCE

A. MAIN ATTIC

(a) Increase Ventilation Area - Insufficient ventilation in your attic may lead to serious moisture problems. Increasing vent area by the amount specified by the adviser will help remove



- First, tape up the joints to prevent leakage. Then take 3 inches (or more) mineral-fibre batts or blankets and cut to size. Special batts with vinyl covers are made for this purpose. Wrap the insulation around the ducts as shown, or else install it lengthwise. Just make sure the entire system is covered, with the insulation taped securely in place. If there is a vapour barrier, put it on the outside for neatness, but slash it to allow moisture to pass.

INSULATING HEATING DUCTS
IN UNHEATED AREAS

(b) Repair Structural Problems - This is recommended if there is evidence of structural problems in your foundations assembly, to ensure a long-lasting insulation job, the structural problems should be repaired before insulating.

(c) Move Water Pipes - Your water pipes will freeze unless they are on the inside of any installed insulation. This means that the pipes may have to be moved in order to properly insulate the foundation.

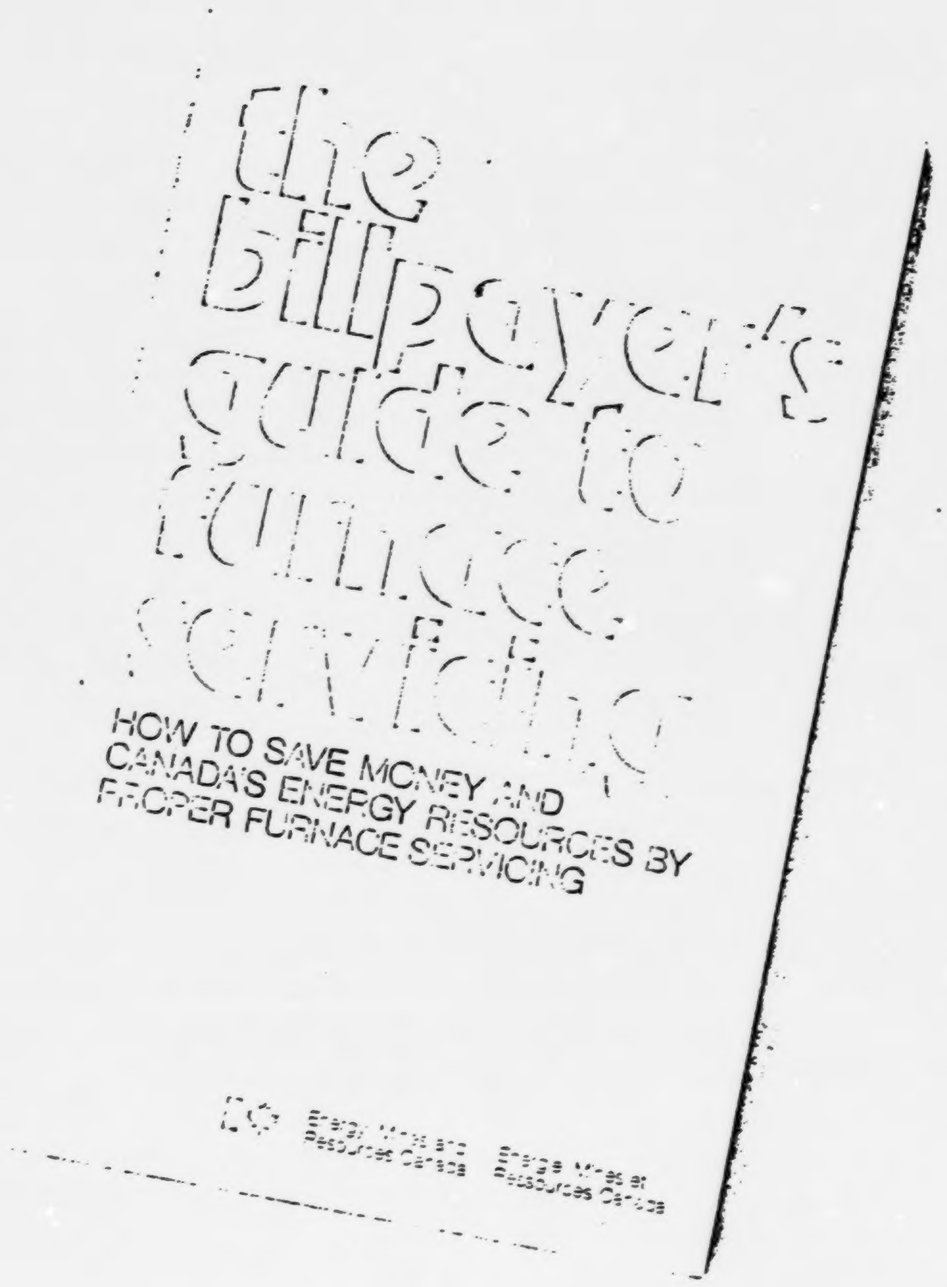
(d) Insulate Basement Windows - Basement windows which are not required for lighting or an outside view should be insulated to RSI 2.1 since they represent an unnecessary source of heat loss. Simply staple in a 3 inch foil-faced insulation batt into the window space.

(e) Insulate Heating Ducts or Pipes - If your heating ducts or pipes are in an unheated area, they should be insulated to avoid unnecessary heat loss.

(f) Tape Duct Joints - The joints in your duct work should be taped to avoid unnecessary heat loss and to improve the efficiency of heat transfer through the duct.

(g) Improve Duct Work - The duct work in your basement needs improvement. Have your serviceman eliminate any unnecessary bends in ductwork and ensure a good fit of your registers to wall or floor areas.

(h) Seal Registers In Unconditioned Areas - Registers acccessing areas of uour home which do not require heat should be sealed to avoid unnecessary heat loss.



the billpayer's guide to furnace servicing

HOW TO SAVE MONEY AND
CANADA'S ENERGY RESOURCES BY
PROPER FURNACE SERVICING

Energy, Mines and
Resources Canada

Énergie, Mines et
Ressources Canada

4. OIL HEATING SYSTEM MAINTENANCE MEASURES

If any of the following measures are recommended discuss them with your serviceman at your next servicing.

(a) Adjust For Thermostat Error - This means that the temperature at which you set your thermostat to turn on the furnace has been found to be inaccurate by the amount indicated by the adviser. By adding (or subtracting) the correction factor, you'll know the actual room temperature at which the heating system turns on for any setting.

(b) Repair Oil Lines - Leaks in the oil line which brings oil from your fuel tank to the burner should be repaired and any rust or corrosion eliminated to ensure efficient and safe operation.

(c) Repair Flue Pipes - For proper operation, your flue pipe may need additional support or better fitting to the heating system. Any rust or corrosion should be eliminated.

(d) Repair Barometric Damper - For proper damping your barometric damper may need lubrication, cleaning or levelling to ensure that it swings freely. Excessive rust or corrosion build-up may mean that the damper should be replaced.

(e) Seal Combustion Chamber Leaks - The gaskets on the furnace or boiler casing or the inspection port seals may need to be improved to ensure efficient combustion air control.

(f) Increase Combustion Air Supply - If your heating system is in an enclosed space, evidence such as soot build-up or back-puffing may indicate to the adviser that your heating system is not getting access to sufficient combustion air. Discuss this problem with your heating serviceman.

(g) Improve Fan System - (Forced Air Systems Only) - To ensure proper fan operation, your fan blades may need cleaning, the fan belt may need to be adjusted, or the bearings may need to be replaced.

(h) Replace Filters - (Forced Air Systems Only) - Dirty filters should be replaced to ensure efficient operation.

5. THE HOME ENERGY CONSERVATION CHECKLIST

The current Enersave checklist provides a useful model for ECAP purposes. However, an improved format and certain content changes are required to achieve compatibility with the ECAP energy survey.

ener$ave
Advisory Service

éner$age
Service consultatif

HOME ENERGY CONSERVATION CHECKLIST

Introduction

Use this checklist in your home. Check off what you're already doing and start working on what's left. You'll save dollars while helping to reduce Canada's demand for energy.

Weatherization

☐ Locate and seal off air leaks; check particularly for leaks into the attic and around the sill plate on basement foundations.

☐ Weatherstrip windows and doors.

☐ Caulk on the inside of window and door frames.

☐ Install storms or double-glazed windows.

☐ Install storm doors or insulated doors.

☐ Insulate attic, walls and basement to recommended levels. (Call our toll free HEATLINE for details.)

Space Heating

☐ Reduce your nighttime thermostat setting to 17°C (63°F).

☐ Reduce your daytime thermostat setting to 20°C (68°F). (Use your lower "nighttime" setting if no one is home during the day.)

☐ Close off unused rooms; reduce temperature to a minimum of 10°C (50°F).

☐ Close drapes (or insulated shutters) at night to reduce heat loss and open during the day to let in the sun.

☐ Keep air registers and radiators clean and free of obstructions.

☐ Have your furnace serviced and tuned annually.

☐ Check the accuracy of your thermostat during each furnace servicing.

☐ Seal your furnace duct work with duct tape and insulate hot air ducts more than 6 feet in length.

☐ Close fireplaces and woodstove dampers tightly when not in use. (Plug unused flues with fire-resistant insulation.)

☐ Keep exhaust fans in good repair and minimize their use in winter.

☐ Install fences, hedges and trees as energy-saving windbreaks.

☐ Determine if your furnace should be downsized if your home has been re-insulated. (Call our HEATLINE for details.)

Hot Water

☐ Turn the thermostat on your water heater down to 49°C (120°F). (Some dishwashers will require a 60°C (140°F) setting.)

Call toll free 1-800-267-9563
In B.C. 112-800-267-9563; Ottawa-Hull 995-1801
Yukon and N.W.T. call collect (613) 995-1801
A service of Energy, Mines and Resources Canada

Appelez sans frais 1-800-267-9563
En C.-B. 112-800-267-9563; Ottawa-Hull 995-1801
Yukon et T.N.-O. appelez à frais virés (613) 995-1801
Un service d'Energie, Mines et Ressources Canada

☐ Upgrade the tank insulation to RSI 3.5 (R-20) by wrapping it with glass fibre insulation.

☐ Insulate long runs of hot water pipe, especially in cool basements.

☐ Drain about 1 gallon of water every 2 months from the tank to remove sediment and reduce scaling.

☐ Turn off your water heater during vacations or weekends away.

☐ Install flow-restrictors and aerators on faucets and showerheads.

☐ Repair leaky faucets.

Summer Cooling

☐ Use awnings, blinds or drapes to reduce heat gain through windows.

☐ Ventilate your attic with outside air.

☐ Maximize natural ventilation of living spaces.

☐ Avoid or minimize the use of central air conditioning; use a portable fan instead.

☐ Keep air conditioners in good repair and set at 25°C (77°F).

☐ Plant shade trees on south, east and west side of the building.

Lighting

☐ Turn off all unnecessary lights.

☐ Reduce lighting wattages to a minimum.

☐ Convert to fluorescent lights where practical.

☐ Keep bulbs and fixtures clean.

☐ Install trilight fixtures and dimmer switches where possible.

☐ Use task lighting (i.e. smaller lights close to point of use).

☐ Make the best use of natural lighting.

☐ Finish the interior of your house with light-reflective colours.

☐ Minimize decorative lighting.

Appliances

Refrigerator/Freezer

☐ Set thermostat to medium range; 3°C (39°F) for refrigerator, -18°C (0°F) for freezer.

☐ Defrost the unit regularly; allow no more than 6 mm (1/4 in.) frost build-up.

☐ Clean refrigeration coils regularly.

☐ Leave room around the back and sides of the unit for air circulation over the heat exchanger.

☐ Position the unit away from heat sources (e.g. radiators, stoves).

☐ Ensure that the door seal is airtight.

☐ Decide on what you want before opening the door.

☐ Avoid overloading the unit.

☐ If you're shopping for a new unit, look for the ENERGUIDE labels which compare monthly energy consumption of various models.

Stove

☐ Use pots and pans with tight-fitting lids, and match pot to burner size.

☐ Use energy-efficient double-boilers,

pressure cookers, slow cookers, and steamers when possible.

☐ Use an electric kettle rather than less efficient stove-top models.

☐ Place aluminum reflectors below stove elements to reflect heat.

☐ Keep oven, elements and reflectors clean.

☐ Check the accuracy of your oven thermostat regularly with an oven thermometer.

☐ Ensure the oven door seal is airtight.

☐ Keep oven door closed during use (20% of the heat is lost per opening).

☐ Turn off oven just before the end of cooking period (and let the meal finish cooking in the contained heat).

☐ Use top elements instead of oven when possible.

Dishwasher

☐ Use only for full loads.

☐ Eliminate drying cycle by letting dishes air dry.

☐ Clean dishwasher screen regularly.

☐ Reduce or eliminate the need for a dishwasher by washing dishes by hand.

☐ Purchase an "energy efficient dishwasher" with its own hot water booster so that your hot water thermostat can be reduced to 49°C (120°F).

Washer and Dryer

☐ Load units to capacity without overloading.

☐ Wash clothes in lukewarm or preferably cold water when practical. Use cold rinse cycle when practical.

☐ Clean the dryer's lint filter after each load. Remove the lint from the dryer motor, drum, and pipes annually.

☐ Keep the drying cycle short to avoid overdrying and set the air temperature as low as possible.

☐ Be sure your dryer is vented to the outdoors.

☐ Try hanging clothes outside in the summer.

General

☐ Follow manufacturers' instructions on use and servicing of appliances.

☐ Select new appliances on the basis of overall energy-efficient design (i.e. fully compare energy conservation features and durability).

☐ Rent or share specialty equipment (e.g. chainsaw, floor polisher).

☐ Do your lawnmowing or snow removal by hand.

☐ Make moderate use of recreation vehicles (e.g. snowmobile, power boat, etc.).

☐ Try low-energy recreational activities (e.g. jogging, hiking).

Recycling

☐ Purchase milk and soft drinks in returnable containers.

☐ Patronize local metal, glass, and paper recycling depots.

☐ Reuse bags, containers, bottles, and wrappings when possible.

☐ Donate discarded items (e.g.

appliances, furniture, clothes) to charitable groups.

☐ Build a compost heap for organic kitchen and yard wastes.

Automobile

☐ Try to reduce gasoline use by walking, bicycling, and using public transit or car pools.

☐ Have your car well tuned and serviced regularly. Maintain proper tire pressure. Use energy efficient radial tires if possible.

☐ Drive at moderate speed.

☐ Avoid rapid acceleration and hard braking.

☐ Use a timer to switch on your block heater 2 or 3 hours before driving.

☐ Avoid prolonged idling (including winter warm-ups).

☐ Shop for fuel economy when selecting a new or used car.

For more information

For more details on any aspect of this fact sheet, or for more information on home energy conservation, call our toll-free HEATLINE at 1-800-267-9563.

B.C. residents call 112-800-267-9563
Yukon and N.W.T. residents call collect (613) 995-1801
Ottawa-Hull residents call 995-1801

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APPENDIX 4

SUMMARY OF REVISIONS TO FIRST DRAFT

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Since the submission of the first draft of the ECAP audit procedure in late July, the following activities were undertaken to refine the procedure for field test use in PEI:

(a) four field tests in Ottawa
(b) detailed technical review meetings on the draft procedure with Scanada Consultants (Bob Platts and Mike Swinton), the Canadian Combustion Research Laboratories (Skip Hayden) and the National Research Council's Division of Building Research (Rick Quirouette, Eric Scheuneman).
(c) discussions with technical staff at a variety of agencies involved in the mainstream of U.S. audit development (Tennessee Valley Authority, Energyworks, and Cornerstones Energy Group).

On the basis of these activities a variety of revisions were made. The revisions include various adjustments in the measures covered and in the calculation methodology to facilitate more thorough and accurate analysis. In addition an effort has been made to streamline the analytical procedure to permit easier and more rapid calculations.

The revisions are summarized below:

(1) Inspection forms were re-organized and reduced in number to facilitate on-site use.
(2) An interview results presentation format and draft copy for supporting information package were developed.
(3) The calculation methodology was programmed for use on an on-site calculator.
(4) The requirement for accompaniment by the client during the inspection was dropped to facilitate inspection procedures.
(5) An improved client interview format was developed permitting direct determination of DHW use and air change estimates.
(6) The hot water use estimate system was revised using Canadian data and adjusted to accomodate variable bath and shower use.
(7) Air change estimates were adjusted upward by .1 change per hour to better reflect PEI housing stock and an upward exposure correction factor of 50% was provided for windy locations.

(8) For homes where fuel records are available, a nozzle sizing system based on actual fuel consumption per degree day was added.

(9) Improved worksheets have been provided on the building dimension form so that the adivser can directly use the dimension data for area and RSI determinatons for all building components including doors and windows.

(10) The window and door forms has been deleted in favour of a more concise worksheet on the building dimension form.

(11) A recommendation to install thermal doors on all regular doors has been added as a parallel recommendation to storm windows.

(12) All envelope inspection forms(including air leakage) have been integrated on one form to facilitate on-site use and data processing.

(13) The detailed air leakage form was considered too detailed for inspection or presentation purposes and has been replaced by a more general assessment of each building component (attic, walls, and foundation).

(14) A variety of minor maintenance flags have been deleted to save time (e.g. thermostat location, inside storms).

(15) The domestic hot water cost factors and savings tables have been revised to account for variations in the actual water temperature (the first version assumed a water temperature of 160°F which led to large inaccuracies.)

(16) The DHW insulation savings are now calculated at a tank temperature of 120°F (assuming temperature setback if necessary) to avoid double-counting savings.

(17) The DHW temperature setback recommendation to 135°F for homes with dishwashers has been deleted and will be replaced with a note in the package explaining that some dishwashers may require a higher 135°F setting.

(18) To permit the field test procedure to deal with inefficient hot water systems, a recommendation to consider unit replacement with an energy-efficient oil system has been added. (Since it is not clear that this is a feasible measure for the ECAP audit, it has not been added to the main recommendations.)

(19) The duct or pipe insulation form has been deleted due to lack of technical consensus about whether fuel savings can actually be achieved by the measure. Ducts and pipes are now treated as a maintenance flag in the heating system inspection.

(20) Based on CCRL estimates, savings for circulation fan setting reduction have been reduced to 4% of the oil heating cost.

(21) To provide a circulation system recommendation for hydronic systems, a recommendation to "add a circulating pump" if no circulating pump exists has been added. (Consideration should also be given to adding an aquastat adjustment recommendation for systems with non-continuous pump operation.)

(22) The super-tuning recommendation was considered unwieldly and has been divided into three parts: (a) a thorough servicing (b) an instrumented tuning at the next servicing and (c) installation of a solenoid valve.

(23) Based on CCRL data nozzle downsizing savings in cases where no retrofit is planned are limited to 3% of the oil heating costs.

(24) To deal with inefficient units older than 16 years (the current cut-off for retrofit recommendations) a recommendation to consider installing a new energy-efficient unit has been added for field test purposes. (This still presents a problem in the ECAP regions since new oil units are not covered under the grant and consequently it has not yet been added to the main set of recommendations).

(25) The building envelope chart has been revised to cover both savings and cost calculations for all insulation and sealing measures. Cost factors per unit of area have been pre-listed.

(26) The free-heat correction factor system has been adjusted to permit a more accurate rating of homes on the basis of occupancy and solar exposure.

(27) The air change heat loss reference table has been revised to a better account for the different relationship between envelope volume and envelope area for standard and non-standard envelope shapes. This permits the adviser to use envelope area rate than volume to calculate air change heat loss.

(28) The RSI reference tables for walls, attic and floor assemblies have been condensed onto one page for easier use. (More work is required to provide improved assistance to advisers in determining RSI-values).

(29) The basement RSI reference table has been adjusted for improved accuracy.

(30) Additional attic insulation can be recommended if the existing insulation is 70% or less than recommended levels. (formerly 50%).

APPENDIX 5

SUMMARY OF MINI-COMPUTER CALCULATION PROGRAM

SUMMARY OF MINI-COMPUTER CALCULATION PROGRAM

The computerized calculation procedure which is now under development for the ECAP survey is based on a Sharp PC 1211 mini-computer augmented by a cassette storage. The mini-computer system is designed to reduce calculation time and adviser error rates by smoothly guiding each stage of data input and eliminating the tedium of the many arithmetic operations of the manual procedure. Because the system increases data capacity, it is also capable of generating more accurate and more extensive information than the manual procedure.

The mini-computer system will also provide a basis for development of more sophisticated systems of computer assistance. However, all indications from other audit programs suggest that it would be unwise to proceed directly with more complex and costly hardware without considerable prior experience in energy audit design and delivery.

At present, the mini-computer program covers only those calculations related to projected fuel costs and insulation analysis shown on the building envelope worksheet. However, it is currently being expanded to cover air tightening measures and to provide sizing guidelines for new or existing oil heating systems.

After refinement of the basic methodology during the course of the PEI field tests, the program can be adapted (1) to perform savings calculations for the space heating and domestic hot water systems, (2) to adjust savings estimates to avoid "double-counting" and (3) to assist the adviser in priorizing and documenting the recommended measures.

The on-site advantages of the mini-computer system are outlined more specifically below:

(1) free heat estimates and volume-to-area envelope indices can be entered directly without the use of generalized reference tables

(2) the heating load estimate which is based on average degree-day values can be corrected for average indoor temperature

(3) a projected fuel cost based on theorectical heat load analysis can be quickly obtained if no fuel consumption records are available

(4) a projected fuel cost estimate based on fuel records can be compared against a projection based on the theoretical building heat load and adjusted for major discrepancies if necessary

(5) the building envelope worksheet can be eliminated from the inspection forms since the mini-computer printout provides a concise record of the calculations (which can be used for data management and quality control purposes

6. FACT SHEET KIT

The following Enersave fact sheets are available for use in energy survey work. New fact sheets on technical issues and regional resources are required.

- The Canadian Home Insulation Program
- How To Avoid Insulation Rip-Offs
- How To Detect And Seal Air Leaks
- How To Ensure Proper Home Ventilation After Retrofitting
- Fire Safety Checklist For Attic Ventilation
- Attic Ventilation After Reinsulation
- Cellulose Fibre Insulation
- Windows
- How To Reduce Your Hot Water Heating Costs
- Retrofit Measures For Oil Furnaces
- How To Select An Energy-Efficient Oil Furnace

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